University of Washington

ARBORETUM BULLETIN

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Concerning this issue...

We deeply regret the resignation from the Editorial Board of R.F. Stettler, Professor of Forest Genetics, U.W. College of Forest Resources. His creative contributions toward the excellence of the *Bulletin* have been immeasurable. His constructive criticism has been invaluable. However, we welcome his replacement, Patricia Gutter of the Department of Landscape Architecture. Pat, we expect great things of you!

We promised last time that we would bring you the latest word on nomenclature. After due consideration, the Editorial Board decided unanimously that we could publish no better article than a reprint—somewhat updated—of Arthur Kruckeberg's treatment in the spring and summer issues of 1964.

Complementing the intricacies of man-made rules for botanical nomenclature, we have a new article by B.J.D. Meeuse describing this time the complexity of nature's rules for the opening and closing of flowers—an example of theme and variation.

And while we are on the subject of theme and variation, we have three articles on gardens—English and American, public and private. Last September Joe Witt represented the Arboretum at a conference held at Kew on the role of botanic gardens in the conservation of rare and threatened plants. While he and Jean were in England, they visited a number of gardens, a few of which they describe in this issue. Joe admired especially the Botanic Garden of the University of Liverpool at Ness, and he solicited an article from its director, J.K. Hulme. In addition, for some time the Witts have known Herb and Margaret Parker of Richland, Washington because Jean is a specialist in iris, a subject which has also interested them. Joe has been greatly impressed that on the edge of the desert of eastern Washington, in a supposedly hostile environment, the Parkers have been able to create and maintain a flourishing garden in the English tradition.

And if you are still hungry for English gardens, be sure to read about the tour that Brian and Margaret Mulligan will conduct in September and October of this year. Perhaps if you act soon enough, you may be among the lucky members of their group.

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Fagus sylvatica 'Rohanii' in April
(See article, page 2)
Photo: G. Pirzio-Biroli

The original weeping birch. Photo: G. Pirzio-Biroli

A Garden in the Southeast Columbia Basin

*H.M. PARKER**

Editor's note: We visited Herb and Margaret Parker in April this spring to photograph their garden for the following article. In early 1979 Richland experienced 30 days during which the temperature never rose above 32°F and the ground froze 35 inches deep. As Mr. Parker says, "You plan for the freeze that comes every nine years, not for the 90-year cycle." The potential disaster that might have resulted from this record-breaking freeze was moderated by intelligent planning and excellent garden practices. The Parker garden has come through with relatively minor damage. The ivy, some of the hollies, magnolias and roses have been defoliated or cut back, but most of them will survive. Rhododendron leaves have been burned. But the fruit trees were in full bloom, the bulbs were magnificent, and many deciduous trees were giving a fine display of young foliage.

"East is East and West is West, and never the twain shall meet" is a global observation. It applies all too well to Eastern Washington and Western Washington. The Puget Sounder knows his ocean, lakes and majestically forested hills are God's country. To the east lies only barrenness, too cold in winter, too hot in summer. The Eastsider knows the subtle color changes in the desert, acres of ripening grain or flowering peaches, and the glory of a cloudless sky. For those who live east of the mountains, Seattle is specifically designed for the encouragement of rheumatism and arthritis; even baseball and football are more wisely played indoors there.

Some notes from those who have gardened on both sides may be of interest. We came from England to Seattle before World War II and enjoyed the city, climate and gardens. The needs of the atomic energy program took us to Chicago and Oak Ridge, Tennessee, and back to Richland in 1944, where we already "knew" that the climate

*Herb Parker was the radiation physicist at the Swedish Hospital, Seattle prior to World War II. Since 1944 he has been connected with the atomic energy program in Richland, WA. He headed the Hanford Laboratories for the General Electric Company until that organization left in 1965. After serving as a consultant to the incoming Battelle Pacific Northwest Laboratories for several years, he retired to private consulting, which allows more time for gardening. His wife, Margaret, specializes in hybridizing tall-bearded irises, and has several worthwhile introductions.

was tolerable only to sagebrush and jack rabbit. What a revelation to find how excellent the climate really is!

Early Richlanders living on government-owned property naturally planted cheap, fast-growing shrubs and trees. In the last 15 to 20 years those gardens have been substantially upgraded. For many years, we specialized in growing irises, with small collections of peonies and lilacs, plants which seemed ready-made for that climate. Twelve years ago, we acquired a two-acre property with one of the few houses preserved from the pre-project days of Richland.

The 1910 house has its original "air conditioning"—five silver maples hopelessly close to the house and reaching 65 to 75 feet. Circumferences at chest height range up to 162 inches. There is an old cut-leaf weeping birch (*Betula pendula* 'Gracilis') 50 feet tall and 84 inches around. The maples qualify as the biggest residential trees in town, and the birch as a reasonable candidate for the most handsome. At one time, the ranch had a large cherry orchard. Five of these overaged cherries remain.

The previous owner, a skilled horseman, maintained four Arabian horses on the property. Thus, while the area adjacent to the house was pleasantly landscaped, the main portions were screened off by an oversized privet hedge and devoted to horse pastures, corrals, a barn and the like. It was quite a challenge to combine the sections into a harmonious whole that would be acceptable as a garden in Seattle or England. All this had to be done against a background that says you really can't "Seattlize" the desert.

The house faces east over the Columbia River. Irises occupy a slope to the east concealing straggly leaves from the house. The rest of our property has been devoted to the planting and study of trees and shrubs. Wherever possible we have made small collections for comparative studies. Although both of us are scientists, we grow trees for pleasure, not scientific study. The only intrusion of science is that a quoted tree height or girth can be trusted.

Since the appetite of the inveterate collector is insatiable, we have arbitrarily limited collections to multiples of eleven and have landscaped around the number eleven in other ways. Fun with trees has been more important than formal landscaping. Eleven related shrubs are more interesting than eleven identical ones.

The outer boundaries are respectable—22 columnar maples on the north, 44 arborvitae on the long west side and 11 Black Hills spruce on the south. Within, there is a basic plan of large trees properly spaced, now obscured by about three times as many trees as should be allowed to grow to maturity. One has to be firm about timely removals. We are wavering in only one combination. A legitimate spacing of *Fagus sylvatica* 'Riversii,' *Quercus rubra* and *Liriodendron tulipifera,* was compromised by adding *Cedrus libani.* We had expected the tulip tree to dominate. The oak (38 feet) has passed it, and the cedar is rapidly overtaking both. What does one do with this now inelegant combination? The cedar's real interest lies in its amazing conversion at maturity to a broad flat top. Young gardeners should make that choice, removing the oak and beech now.

GROUND RULES

1. Unlimited irrigation with garden subdivisions separately controlled is conventional.
2. We arbitrarily exclude the use of special fine sprays or misters without which some plants are in jeopardy in a prolonged hot spell.
3. When practicable we buy three like specimens, since individual plants vary.
4. Recognizing that a particular plant may die because it was substandard when received, was improperly planted, or was given the wrong environment above or below ground (or all of the above!), we use baseball rules—three strikes and you're out. At present, only a dove tree *(Davidia involucrata)* is threatened by this rule.
5. Soil amendment by sprinkling with sulfur, aluminum sulfate or acid fertilizers is no more difficult than fertilizing and is allowed. Preparation of a distinctly acid bed to root depth is normally too much trouble. Acidifiers leach away and need renewal.

The east lawn with one of the silver maples on the right. Photo: H.L. Parker

Feature	Seattle and Environs	Richland and Environs
Soil	Glacial till with impervious layers	Dry sands and riverwashed gravels
Natural soil pH	5.0—6.5	7.5—8.2
Natural vegetation	Cedar-hemlock, Douglas fir forest	Sagebrush-steppe
Hours of sunshine:		
Summer	760	1130
Annual	About 2000	2900
Annual precipitation (in.)	About 32	6.3
Growing season (days)	220—240	175—190
Relative humidity percent*	January: 85 July: 65 April: 75 October: 85	January: 75 July: 30 April: 45 October: 55
Temperature °F:		
Mean winter minimum	35	25
Mean summer maximum	65	85
Average annual days:		
Below 32° F	About 40	110
Above 90° F	About 5	55
Hardiness zones:		
USDA	8a—8b	6b
Arnold Arboretum	8	6
Sunset magazine	5	3

*The actual moisture content of the air is about 2½ times greater in Seattle for most of the year.

Table 1. Comparison of natural growing conditions between the areas in and around Seattle and Richland.

6. We mulch new trees with tree bark for two seasons, then add black plastic under the bark to control tough weeds. Despite the vigorous growth of new trees in a decade, we have added more wood as bark (200 cubic yards) than we have grown as wood in the trunks and main branches of the new trees (60 to 80 cubic yards).

CLIMATE AND GROWING CONDITIONS

Seattle and Puget Sound are separated from the Tri-Cities and the southeast Columbia Basin by the Cascades and the great bulk of Mt. Rainier. Natural growing conditions are widely different. Some of the factors are compared in Table 1.[1]

Garden growing conditions are not nearly as divergent as the natural features because of the ad-lib irrigation. The important factors are soil acidity, drainage and extremes of temperature.

Soil acidity cannot be changed radically except for individual small plantings. After cultivation, our soil runs pH 6.5 to 7. With surface amendments it is hard to get much below pH 6.

The drainage factor favors Richland—root rot and the like are essentially unknown. Conversely, the location is highly unsuitable for bog-loving plants.

[1]Puget Sound data are approximated from Reference 1.

Temperature extremes are critical.[2] Conventional plant hardiness zones are essentially a measure of the averaged winter low-temperature extremes over a 40-year period. The hardiness zone is probably the single most important parameter available to the amateur gardener. In regions where minimum temperatures are reasonably consistent, as in Seattle, the zone index is reliable, except for unusual or contrived microclimates. A salient feature of the Basin climate is the extreme variability in winter.

[2]Climate details for the Columbia Basin area are from Battelle Pacific Northwest Laboratories (Reference 2 and subsequent annual reports). The measurement point was Hanford Township on the banks of the Columbia from 1912 to 1942. After 1944 the reference was the Hanford Meteorology Station, 10 miles WSW of Hanford and 25 miles NW of Richland. Proximity to the river moderates temperature, and increased elevation as one leaves the river moderates *both* winter and summer temperatures. Special conditions near the Columbia and Snake rivers create a rather uniform climate over a saucer-like area east from the Hanford station and some 30 to 40 miles across, with an extension 130 miles east to Lewiston, Idaho (the so-called Banana Belt). For the last 30 years, annual minimum temperatures averaged as follows (data courtesy of Wayne A. Stone, BNWL): Hanford Meteorology Station, −1.4°F; Richland, +1.6°F; Walla Walla, +3.7°F. Both Richland and Walla Walla would qualify as Zone 7a in this period. Limited records over the previous 30 years show distinctly colder weather.

Richland has moderate winters for years in a row, punctuated randomly by brutal cold ones once in about nine years. Monthly mean temperature for January shows a recorded high of 42.5°F and a low of 12.1°F. This represents a range of 30.4°F from 1912 to date, whereas the July range is only 9.4°F. Lowest recorded temperature in December is −27°F, the highest 68°F, a phenomenal swing of 95°F. Just as important as the ultimate low temperature is the temperature pattern preceding it. As is well documented for fruit trees, a steady fall promotes astonishing protective action. A sudden, less severe drop in early winter can be devastating.

Upper temperature variations are less dramatic, yet I believe that stressful hot spells constitute the greatest hazard on the east side. Annual days above 100°F average 13 compared with one or fewer in Seattle. The killers were 11 consecutive days in 1938 and again in 1967. Any deficiency in watering at such times means serious loss.

CONIFERS

Nearly all conifers that grow in Seattle will grow 50 percent faster in Richland because they get more solar energy input. This seriously distorts landscape plans if one is used to gardening in less sunny climates. Pines that normally grow out of scale in 10 to 13 years do so in 6 to 7 years here. Conifers not faring well here are those that conspicuously like wet feet or a humid atmosphere or both. Thus western hemlock *(Tsuga heterophylla)* and western red cedar *(Thuja plicata)* that add majesty to the Seattle skyline are not naturals here. Other hemlocks *(Tsuga canadensis, T. caroliniana, T. mertensiana)* and American arborvitae *(Thuja occidentalis)* do exceptionally well. Douglas fir *(Pseudotsuga menziesii),* the other common Seattle native, grows well but is incompatible with our collection of 11 spruce species. We enjoy Colorado blue spruce *(Picea pungens)* despite its unfashionable overplanting. In our conditions, 'Moerheimii' is clearly the bluest; 'Hoopsii' is the most silvery; 'Koster' gives the best display of cones.

An attractive group has three Engelmann spruce *(Picea engelmannii)* varying in height and blueness. The tallest grew to 20 feet in eight years, is only 7 feet across and is the "pointiest" of our trees. *Picea jezoensis, P. omorika* and *P.orientalis* rank as favorite spruces. All thoroughly enjoy Richland sunshine. Not so the firs. *Abies procera* dislikes the extreme dry spells, although the blue form is a little more tolerant. *Abies concolor* is widely planted. We grow *A. balsamea* f. *hudsonia, A.b.* 'Nana,' *A. koreana, A. lasiocarpa* var. *arizonica, A. pinsapo* and the stunted alpine firs, which surprisingly stay small.

Our 22 species of pine need not be enumerated. All do well and march to the fast drummer. We simply acquire as many as we can, compatible with Richland hardiness. Lace-bark pine *(Pinus bungeana)* is our favorite though our specimen is immature. Next are the Himalayan pine (forgiving its nomenclatural changes—*P. excelsa* to *P. nepalensis* to *P. griffithii* to *P. wallichiana)* and a weeping *P. strobus* with a trunk like burnished copper. I covet the striped Himalayan pine in the Gotelli Collection, National Arboretum, but have never found a source. The 'Oculis-draconis' varieties are very poor substitutes for *P.w.* 'Zebrina.'

Other good pines include *P. sylvestris* 'fastigiata' (15 feet) and the perfectly symmetrical 11-foot, cone-shaped *P. balfouriana,* compared with bristlecone *(P. aristata)* which is randomly branched and has resinous dandruff.

The street side boundary has 22 large arbor-

Tallest of the three Engelmann spruce with 40-foot *Metasequoia* on left. Photo: H.L. Parker

***Fagus sylvatica* f. *pendula* in April. Photo: G. Pirzio-Biroli**

vitae kept topped at twenty-two feet (and eight feet across) and 22 pyramidal arborvitae kept at six feet. The tall ones provide late afternoon shade for such things as stewartias, franklinias, cryptomerias and the dove tree.

The cryptomerias are so soft and "Japanesy" that they are irresistible. They are marginally stressed in the summer and would be happier in Seattle.

The dawn redwood *(Metasequoia glyptostroboides)* has grown 40 feet in 10 years. It is developing the characteristic buttress, making it look even more like a relative of bald cypress *(Taxodium distichum)*.

DECIDUOUS TREES AND SHRUBS

The basic planting relies heavily on recommendations of the Brooklyn Botanic Garden (3)[3] and Donald Wyman's texts (4,5). Rejected on personal prejudice were Russian olive (too gray), willow oak (wrong leaf shape), redbud (a revolting color). One criterion was to have at least one tree in bloom throughout the season, which begins in March with apricots, *Magnolia soulangiana* and white forsythia *(Abeliophyllum distichum)*—discounting inconspicuous maple flowers and winter jasmine. It ends in September. *Sophora japonica* and *Franklinia alatamaha* are the last to bloom (late July or August), but the silk trees *(Albizia julibrissin* f. *rosea)* begin in June and have a new crop daily through September.

Our favorite flowering tree? Too hard to choose from:

Malus × *arnoldiana* of the 22 crabs
Prunus serrulata 'Shirofugen'
Cornus florida (*Cornus nuttallii* would be superior if it grew Seattle-fashion. Does flower twice.)
Chionanthus virginicus for the delicacy award
Albizia for three-month flowering effort

Our 44 fruit and nut trees should be included although they were chosen for fruit value rather than ornamental appeal. This category outclasses Seattle, especially for the soft fruits—apricots, peaches, nectarines and plums.

With limited space, we selected maples as a collection of twenty-two. We learn more about their freedom from disease, beautiful spring foliage and brilliant fall color each year. A secondary collection of 11 birches complements the patriarch birch. We include *Betula albosinensis* var. *septentrionalis* and *B. jacquemontii* because the names are as euphonious as the trees are graceful.

One character defect is addiction to weeping trees. An 18-foot *Fagus sylvatica* f. *pendula* will be a showpiece by the year 2000. *Malus* 'Red Jade' is a winter bright spot. Another addiction is to fastigiate trees. When grouped in islands they landscape well—hide utility poles and make backdrops for shade-needing evergreens. *Quercus robur* 'Fastigiata' (30 feet) and Dawyck beech *(Fagus sylvatica* 'Dawyck') combine well with pointy conifers such as the fastigiate Scot's pine (15 feet), incense cedars *(Calocedrus decurrens)* and *Chamaecyparis nootkatensis* 'Pendula' (10 feet).

Based on performance of 28 trees grown by Dr. R.L. Ticknor and by us, our deciduous trees grow 25 percent faster than those in the Willamette Valley (6). I suspect they lead Seattle by nearly 50 percent as do the conifers. Seattle landscapers grace our public buildings with London plane. There are 500 of them around one laboratory

[3]Numbers in parentheses refer to numbered references at the end of this article.

complex in Richland. They are prone to blight in the presence of alfalfa, apparently, and grow so fast that the laboratory and the public library will be engulfed in another decade. Those familiar with Aix-en-Provence, which has a climate similar to ours, will recall the difficulty of finding the town among its planes.

BROAD-LEAVED EVERGREENS

Richland is unkind to laurels, camellias, box, aucubas and others that do well in Seattle. Standbys are barberry and Oregon grape. *Mahonia aquifolium* does well in full sun, contrary to popular myth. We have good luck with *Abelia grandiflora* and various hollies.

Hollies are a natural interest for an English family. The excellent resource of Brownell's in Milwaukee, Oregon makes selection of top varieties easy. How many other nurseries can (or will) give you a typed list of all the plants you have bought in 12 years? As a result, hollies form our largest collection; 55 plants cover 44 types of which 22 are *Ilex aquifolium.*

This experience belies standard wisdom. The USDA uses *Ilex aquifolium* as an indicator plant for Zone 7. W.S.U. Extension Bulletin 592 (7) does not even include *I. aquifolium* in 400 plants recommended for the Pacific Northwest. Clearly it is perfectly hardy in our Zone 6b, given some shade and protection from drying winds. One can test its reserve hardiness by studying the variegated forms. 'Silvary' and 'Silver Plane' have a 15 to 20 percent silver rim with no chlorophyll; 'Silver Porcupine' has 25 percent silver; 'Golden Queen' has a 30 percent margin. All these grow vigorously here. However, the reverse variegated types like 'Silver Milkmaid' do not survive. They

Fastigiate Scots pine with other narrow trees clustered around utility pole. Photo: G. Pirzio-Biroli

lack up to 60 percent of their chlorophyll production. In 'Green Shadows' the variegation is a light green, which might be expected to be chlorophyll supportive; it is unstable. This chlorophyll ratio test may be a bit oversimplified. Not only does it assume that chlorophyll production is equally efficient over the leaf surface, but it ignores other possible genetic weaknesses; for example, orange-berried plants are less vigorous than either red or yellow types.

Ilex cornuta grows reasonably but not luxuriantly. The compact *I.c.* 'Rotunda' is superb. An unusual variegated type survives unhappily. Bulletin 592 describes *I. crenata* as marginal for Zone 7 and variety 'Convexa' marginal for Zone 6, not responding well to the hot, dry conditions. By contrast, we place these Japanese hollies in full sun and desiccating wind where they grow without blemish, and discard our English hedging box which does dry out.

American hollies *(Ilex opaca)* are generally downgraded because they lack the lustrous dark green leaves of *I. aquifolium*. This is undeserved. They are hardy and make well-shaped trees. Some have exceptionally harmonious combi-

***Chionanthus virginicus* with arborvitae hedge in background. Photo: H.L. Parker**

nations of leaf and berry. 'Morgan's Gold' has better color than the English yellows, and 'Emily' has a purplish tint not found in any other holly berry. For unknown reasons, male *I. opaca* does not do as well.

Among the species, *Ilex pernyi* 'Veitchii' is most handsome. It berries profusely without a mate. The interesting *I. pedunculosa* gave none of its longstalked berries until a male was provided. *I. latifolia* has large unhollylike leaves and could stand in for laurels.

Species	Types	Apparent Hardiness
I. aquifolium	22	Hardy except reverse-variegated
I. × *altaclarensis*	2	Hardy
I. cornuta	3	Marginal
I. crenata	4	Hardiest
Individual species	5	Mostly hardy
Other hybrids	3	Hardy

Table 2. A comparison of the hardiness of holly types in the Parker garden.

ERICACEOUS PLANTS

Puget Sound was doubtless created for the benefit of the Ericaceae. Basin conditions seem wholly hostile to them. Yet a reasonable display can be obtained with a little patience.

Soil pH amendment, moisture retention in the root zone and protection from the extremes of temperature and wind are all needed. The secret of success is that many species do not need *major* amendments. One must have enough courage to resist those that do. Hardiness is probably the fourth most important factor, although I know of no reported systematic studies to test all stress factors against each other.

If a planting is restricted to members of appropriate hardiness, cold weather will not trouble it. If it is to be a focal point in landscape design, it should be one zone safer to take care of the one bad winter in nine. However, it takes too much self-discipline to follow these precepts. There are always some plants that one *must* have contrary to common sense. The first go into preferred sheltered locations, do well and tempt additions that escalate to unreasonable work. If the United States had a Tree Surgeon General, he should require all trees to be labeled, "WARNING—Overzoning can be dangerous to your health and welfare."

We shall condense comments to note form. Omitted are some 20 genera of the 31 represented in the Arboretum (cf. 664 for Rhododendron alone). Order and numbering (shown in brackets below) follow Rehder (8).

Rhododendrons [5]

Named hybrids include 'Cynthia,' 'Alice,' 'America' on a north wall.

'Pink Pearl,' 'Blue Peter,' 'Fastuosum fl. pl.,' 'Purple Splendour.' These were 99-cent items now grown to five or six feet in a decade without loss, only three feet away from the house on the east wall.

Red group—'Mars,' 'David,' 'Vulcan,' 'Jean Marie de Montague' lightly sheltered—all hardy.

J. Henny's 'Cotton Candy'—softest hybrid, blooms every other year. 'Carita,' 'Unique' not quite hardy. Exbury hybrids very hardy—better in sun than shade.

American Rhododendron Society ratings very realistic. W.S.U. Bulletin 592 ratings at least one zone too conservative.

Species: Random collection as recommended by Wells-Medina Nursery, Arboretum visits, et cetera. No losses—all bloom regularly. *Rhododendron albrechtii* is a favorite. First bloomer: a lost-name pink on the east side (mid-March). Six dwarfs (for example *keiskei* and *pemakoense*) have superb foliage in light shade.

Curiosity: Between about 25°F and 0°F rhododendron leaves reflex toward the stems to a degree proportionate to the cold. Different varieties cover different ranges. Excellent thermometer at breakfast.

Kalmia [11]

Kalmia latifolia struck out. *Kalmia polifolia* goes more quickly. Apparently need more acidity than rhododendrons despite what the books say.

Daboecia [13]

Daboecia cantabrica satisfied with a dab of peatmoss.

Enkianthus [14]

Losing battle, similar to *Kalmia*.

Pieris [18]

Pieris japonica in various flower and leaf colors does well. *Pieris* also plays thermometer.

Oxydendrum [21]

Three *Oxydendrum arboreum* grown without shade. Growth inferior to Seattle but fall color superior. Acidified more than other trees, yet

may be losing ground as root balls grow. Shade would help.

Comment on fall color—outstanding in order of merit are: *Stewartia pseudocamellia, Oxydendrum arboreum, Acer japonicum* 'Aconitifolium,' *Quercus macrocarpa, Fothergilla gardenii, Acer palmatum* var. *dissectum* cultivars and *Rhus glabra* naturalized. *Oxydendrum* only ericaceous contributor.

Leucothoë [22]

Leucothoë catesbaei (now properly *L. walteri*) should be in our plantings.

Gaultheria [24]

Salal *(Gaultheria shallon)*—miserable compared with Seattle.

Pernettya [25]

Pernettya mucronata grows adequately. Berries look artificial.

Arbutus[26]

Madrona *(Arbutus menziesii),* our favorite in Seattle. Out of the question here. Miss it most.

Arctostaphylos [27]

Kinnikinnick in Kennewick. *Arctostaphylos uva-ursi* flourishes. Manzanitas otherwise unsuitable.

Calluna[29] *and Erica* [30]

Calluna more stressed of the two. Use light shade. Cultivars such as 'H.E. Beale,' 'J.H. Hamilton' and 'Mrs. Ronald Gray' fine. Yellow or gold types die out.

Erica excellent. *E. herbacea (carnea)*—'King George,' 'Springwood White,' 'Vivellii' are easiest. *E. cinerea, E.* × *darleyensis* and *E. tetralix* OK. *E. mediterranea* (now properly *E. eringena*) not hardy.

None need notable acidity. pH 6.5 adequate.

We both came from the moors of North England. Impact of heath and heather in the desert isn't quite right.

Vaccinium [34]

Blueberry *(V. corymbosum)* provides edible fruit from specifically acidified beds. Marginal at best. Huckleberries, bilberries et cetera unsuitable.

TRIALS, TRIBULATIONS AND OCCASIONAL TRIUMPHS OF THE AMATEUR

Isolated from Arboretum resources and either too lazy or dumb to interpret differentiations in Rehder, the amateur must be reconciled to a few percent mislabeled plants. Mostly, errors are slowly weeded out by informed visitors. But suppose we favored the *Cedrus libani* only to find in 1999 that it is really a green *Cedrus atlantica*?

All nurseries make mistakes, but the best tell you when they later suspect a mistake and search for the requested species. Eastside tours by U. of W. students could be mutually beneficial by catching our errors and acquainting them with our growth patterns.

Disease problems are relatively minor and county extension agents remarkably constructive in that field. We saw fire blight for the first time last year and eventually located the source in the vicinity.

Local nurseries cannot be expected to stock too many special varieties, so plants of car-trunk size must be sought in Seattle, Portland, Salem et cetera. Shipment of large sizes to an amateur is impractical nowadays.

Since the amateur relies so much on hardiness ratings, it is absurd that the USDA and Arnold Arboretum systems have different temperature boundaries. Prominent Atlantic Coast horticulture magazines compound the crime by specifying Arnold zones.

In the West, the more detailed *Sunset* magazine system is internally consistent. However, *Sunset* missed a good bet by not combining the two as USDA/*Sunset*. On that scheme, Seattle would be 8a/5, Skykomish would be 6b/1 and Richland 6b/3, explaining that Seattle and Richland are more look-alike than Seattle and Skykomish, except at the limit of hardiness.

In the nature of triumphs, the first came after

Tanyosho pine (*P. densiflora* 'Umbraculifera'), one of a pair at top of the rockery. Photo: G. Pirzio-Biroli

seven years when, with trepidation about its irreversibility, we removed 350 feet of the old 6-foot by 7-foot privet hedge separating the people domain from the former horse domains. With the installation of a rockery and other manipulations of the connecting section, the parts did integrate better than amateur landscapists deserved, perhaps.

The continuing triumph is the demonstration that a garden which would be acceptable in the Puget Sound area can be maintained in the Columbia Basin without resorting to extraordinary measures. An increasing pleasure comes from the number of gardening friends who now visit us to assist in their own selection of choice trees.

The ultimate triumph might be if these notes prevented the phobia of banishment in any Sounders who may find themselves "condemned" to a sentence in the Basin. If that is your fate, start a Seattle garden here with confidence that it will work and will grow to good size in much less time than you expect.

In the end, "East is West" or very nearly so, and once or twice a year you can take sun-ripened fresh fruit to friends or family in Seattle in exchange for a few days of contemplation of the madronas, cedars, hemlocks and Douglas firs.

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Flowering peach looking east over a peaceful stretch of the Columbia River.

Photo: G. Pirzio-Biroli

The Parker garden was ablaze with tulips and narcissi when many of the foregoing photographs were taken in late April. Every year the Parkers make large purchases at:

THE ANNUAL ARBORETUM FOUNDATION FALL BULB SALE

Tuesday and Wednesday, October 2 & 3

A single list will be sent to a large mailing list, including all members of the Arboretum Foundation. There will be no pre-orders. All bulbs will be available at the sale, which is open to the public.

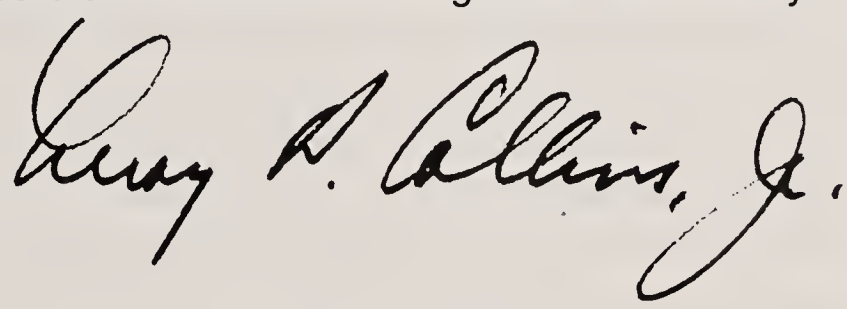
President's Message

The schedule for the City Council's consideration of the Master Plan Update for the Arboretum has not been able to keep pace with the timetable outlined in the previous *Bulletin*. Production of the Final Environmental Impact Statement (EIS) encountered problems but it is now being printed. At this writing, it appears that the Council's Parks and Community Services Committee, chaired by Mr. George Benson, could address the Plan in May or early June and the full City Council could act immediately thereafter. I recommend members keep in touch with Mr. Benson's office or the Foundation office so that the membership can be represented at these meetings.

The other development is more encouraging and very exciting: By the time you read this report, the University of Washington should have named a new Arboretum Director, following the sequence described in the Spring issue of the *Bulletin* by Dr. Lawrence C. Bliss, Chairman of the Arboretum Director Search Committee and by me. The Foundation participated in the search.

As long ago as last September, some of your Foundation's directors were concerned enough about the future of the Arboretum that a motion was made at the September meeting of the Board of Directors to explore the idea of funding by the Foundation for a part of the salary of a new Arboretum Director. The motion passed, a committee was appointed and discussions were held with the University. At the end of March, Dr. George Beckmann, University Provost, suggested in a letter that the Foundation participate in the funding of the new Arboretum Director's office by contributing $15,000 per year for a period of five years, adding to the annual sum of $50,000 committed by the University. The Foundation executive committee authorized a special meeting of active directors; it was held on April 27. After discussion, the measure was unanimously adopted. A $75,000 portion of the Dr. William Fraser Tolmie Memorial Fund has been set aside for this purpose. The remainder of the $90,000 per year required for the Arboretum Director's office will be furnished by Mr. Prentice Bloedel and by the Northwest Ornamental Horticultural Society.

In summary, the Arboretum and the University in the larger context, are moving forward to new heights of endeavor. We in the Arboretum Foundation can take satisfaction in our part in both the Master Plan Update and in the securing of a new Arboretum Director who will guide the University's efforts in the expanded program.



Notes and Comments

The Arboretum Foundation has received a number of sizeable contributions for memorial plantings in the Arboretum. For one reason or another these have never been utilized. At a Memorial Committee meeting in late January it was decided that a hillside area of about two acres on the east side of Azalea Way south of Loderi Valley would be developed, using these funds, and that additional maintenance funding from the Foundation would be donated on a yearly basis for maintenance of the plantings. The memorial plantings will consist primarily of rhododendron hybrids developed by American hybridizers with an over-story of magnolias. As of May 1st, the site has been cleared of underbrush and a trail roughed in. Pruning on the large Oregon Maples is planned for the summer and the first planting should go in in the autumn.

J.A.W.

Mr. Minoru Takahashi, the gardener in the Japanese Garden, returned to Japan in May to celebrate his 88th birthday anniversary, called "bei-ju" or "Rice anniversary" because of the similarity of the Japanese characters for "88" and "rice." Before he left, he was presented with a gift of $100 in yen and a red hapi coat, symbolic of the occasion, from the Arboretum Foundation.

The Naming of Plants—Part I

*ARTHUR R. KRUCKEBERG**

Editor's note: Dr. Kruckeberg has kindly consented to update the following article, originally published in two parts in the Arboretum Bulletin *in 1964. He has added a section on nomenclatural changes, which have become increasingly troublesome in recent years to gardeners and botanists alike.*

The 13th International Botanical Congress convenes in Sydney, Australia during August of 1981. Should any of the details of this event reach the pages of the daily press, I would predict that only garbled accounts of new discoveries in plant disease, horticulture, antibiotics, or plant breeding would be heralded. Yet, in fact, this international body convenes every five years not only to review the progress in botany as a whole but to consider proposed changes to the rules of botanical nomenclature.

The Naming of Plants

The agenda of the Nomenclature Section would read as much like a legal document as it would a botanical one. Practitioners of the "art" of nomenclature have to follow intricate rules. Moreover, these rules are codified, largely stabilized and rarely changed under international agreement. I have before me a 400-page book, *The International Code of Botanical Nomenclature,* which sets forth in English, French and German the principles, rules and recommendations for the naming of plants. Portions of the preamble to the Code will reveal the basic intent of botanical nomenclature:

"Botany requires a precise and simple system of nomenclature used by botanists in all countries, dealing on the one hand with the terms which denote the ranks of taxonomic groups or units and on the other hand with the scientific names which are applied to the individual taxonomic groups of plants. The purpose of giving a name to a taxonomic group is not to indicate its characters or history, but to supply a means of referring to it and to indicate its taxonomic rank. This Code aims at the provision of a stable method of naming taxonomic groups, avoiding and rejecting the use of names which may cause error or ambiguity or throw science into confusion. Next in importance is the avoidance of the useless creation of names. Other considerations, such as absolute grammatical correctness, regularity or euphony of names, more or less prevailing custom, regard for persons, etc., notwithstanding their undeniable importance, are relatively accessory.

"The only proper reasons for changing a name are either a more profound knowledge of the facts resulting from adequate taxonomic study or the necessity of giving up a nomenclature that is contrary to the rules."

The actions caused by this last paragraph are the source of much acrimony and misunderstanding, especially for those who find a long-cherished name suddenly rejected and replaced by a new name for the same plant. All very legal and indeed mandatory are such changes, but a source of headaches for the user. We take up the matter of name changes a bit later.

Despite an occasional name change, botanical nomenclature is blessedly conservative. The impressive body of stabilized nomenclature and its eminently workable machinery for keeping the names of over a million kinds of plants in order is a tribute to the several generations of plant taxonomists who have erected an orderly system to cope with Nature's vast floral diversity. Within the framework of regulated and stabilized plant nomenclature, we will now begin to examine the "what," "how" and "why" of plant names.

Common Versus Latin Names

Initial encounters with plant names are usually painfully unrewarding. To confront the Latin name, *Gaultheria shallon,* for the first time is bad enough, but if you are an easterner, the common name, "salal," is not much better. It is simply that a strange name has no inherent information content. But having been shown a specimen with its nametag fills the information gap. Both names now have meaning. Then why not use common names exclusively? If each kind of plant were unique—without kinship to any other kind—then

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a simple common name might do. But within Nature's array of diversity there is also the strong element of relatedness. Thus, two kinds of *Gaultheria,* when called by their common names, "salal" and "wintergreen," are forever separated. But, by their Latin names, *Gaultheria shallon* and *Gaultheria procumbens,* the two are joined in *Gaultheria* to reflect their bond of kinship.

We must relegate common names to subordinate usage for other reasons. First, they lack universality of application. Common names are usually indigenous to a single country, or even only to one part of a country. In Europe the inhabitants of a single village or valley may have passed on a local name for generations. The bipolar shrublet, *Empetrum nigrum,* is a simple case: Americans call it "crowberry," the Russian says "vodynika" and the German says "Krahenbeere" or "Rauschbeere." For more aggravating and picturesque examples we can turn to the flora of rural England; the Briton has been lavish with common names for one and the same plant. In that delightful work by Geoffrey Grigson, "The Englishman's Flora," I counted nearly a hundred different common—and very often local—names for *Caltha palustris:* to name a few, marsh marigold, bachelor's buttons, cups and saucers, water goggles, et cetera, *ad nauseam.* Then, sometimes the same common name may apply to several very different plants. The name "may flower" has been given to *Podophyllum* in the midwest, to a member of the Heath family in New England, to the hawthorn, marsh marigold and cuckoo flower in England and to a legume in the West Indies. Though such examples could be repeated *ad absurdum,* I cannot resist just two more to further the proof of confusion in common names. A handsome member of the sunflower family was called "Venus' paint brush" when it first appeared in America; later, as it proved to be an aggressive noxious weed, it became known as the "Devil's paint brush." Finally, there is the case of corrupted meaning through centuries of usage. Plants of the genus *Cornus* were once called "dagwood," as "dags" were made of its wood for use as skewers. Need I tell you its present form and corrupted meaning? To be historically correct, you should call our native "dagwood" the skewerwood—if you wish!

The use of common names really breaks down in a ludicrous fashion when they are "manufactured." A large portion of the flora of any region consists of plants largely ignored by the layman and hence devoid of any common names in everyday usage. Yet, when writing a manual of such a regional flora, the author may be compelled to give each species a common name, since he may have listed some for species where the common name is in wide usage. "Tweedy's rattleweed" does not add much to the binomial, *Astragalus tweedyi,* does it? Are you any better off knowing that *Tropicarpum capparideum* can also be called "caper-fruited tropicarpum"? Enough said of common names—established as well as contrived—except to say that when in wide lay use they should be retained and used. But they do not serve well the conduct of the international business of scientific botany.

The Binomial or Latin Name

There is really nothing scientific about the so-called "scientific name" in biological nomenclature. It is derived neither by experiment nor by observation and it cannot be tested like a hypothesis. Yet it is the only valid "handle" which can be attached to organisms. The scientific or Latin name is a compound of two Latin or latinized words, the generic and the specific epithets. This double epithet is the species name. Thus the binomial, *Pinus ponderosa,* is applied to a particular kind of pine—one with a distinctive ensemble of structural features and which occurs in self-reproducing populations throughout a wide but delimited geographic and ecological range.

Let us emphasize the last point with an example of horticultural value. The name, *Rhododendron racemosum,* stands for a particular kind of rhododendron. This binomial may be used to single out an individual plant in a garden or nursery bed, or a plant in its native habitat in western China. But more fundamentally, *R. racemosum*[1] is a collective name standing for all the individuals which have the aggregate features of this plant. Where the kind of plant is only known in the wild, its species name stands for the system of natural populations made up of interbreeding individuals conforming closely to the species description. For plants of horticultural value, the binomial Latin name would apply collectively to both natural populations and to the array of individuals in cultivation.

[1]Note that we can abbreviate the generic name when using it later in the same text—if no other binomial is interposed.

When referring to a kind of plant the binomial *in toto* must be used—written or spoken. In our example of *Rhododendron racemosum,* the word "racemosum" by itself is useless. It could be (and is!) applied to another species in any other genus. The generic epithet, *Rhododendron,* does have information content when used alone. But as such it no longer refers to a particular kind. It, by itself, connotes an unspecified kind, or more than one kind, or all kinds within the collective group, the genus.

A word now about those cryptic abbreviations following a binomial. Each species name is the product of authorship, wherein the original describer of the plant bestows, together with his printed and often illustrated description of the new species, his signature. Thus the full citation of salal is *Gaultheria shallon* Pursh. *Fl. Am. Sept.,* 283. 1814. (Lewis, Columbia R.). Deciphered, this statement tells us that *G. shallon* was published by one Mr. Pursh in the *Flora Americana Septentrionalis,* on page 283, in 1814, from a specimen collected by Lewis on the Columbia River. For another species of *Gaultheria, G. hispidula* (L.) Muhl. *Cat. Pl.* 44. 1813, we encounter a more complicated citation. The letter in parentheses stands for Linnaeus who published this species under another genus *(Vaccinium).* Muhlenberg felt that the species belonged to *Gaultheria,* not to *Vaccinium;* he therefore made the name change but by rule retained the name of the original author. For another ericaceous plant, *Allotropa virgata* T. & G. ex Gray, *Proc. Am. Acad.* 7:368. 1867, the "ex" is the added complication. By this device the provisional name of Torrey and Gray is made valid by Gray's later publication of same. Note also that those who figure prominently in botanical authorship are frequently designated by an initial: L. for Linnaeus, T. & G. for Torrey and Gray, H.B.K. for Humboldt, Bonpland, and Kunth, et cetera. After all that on binomial authorship you will be pleased to learn that no one ever uses the authors' names in speech, nor are they usually used in horticultural or gardening publications. But perhaps some reader's curiosity is now satisfied.

The Taxonomic System

Our discussion of the binomial suggests that the two categories of plant names—genus and species—are collective terms. The species category collects unto it individuals, while the genus contains one to many species. Both categories are levels of inclusiveness; one (the genus) more inclusive than the other. In fact, the whole vast array of biological diversity—all the species from tundra to tropics can be "nested" in successively more inclusive categories. This hierarchy of categories constitutes the taxonomic system. Though the lowest level is logically the individual, the species is actually the lower formal rank; the variety or subspecies often is subordinate to the species. The catalog of categories does not stop here, however. When looked at from above, the most inclusive category would gather unto itself all plants—the Kingdom Plantae. Looking downward from maximum to minimum inclusiveness we find the following array of categories:

Category	*Example*
Kingdom	Plantae
Phylum	Tracheophyta
Subphylum	Pteropsida
Class	Angiospermae
Subclass	Dicotyledonae
Order	Ericales
Family	Ericaceae
Genus	Rhododendron
Species	calostrotum
Variety	calciphilum

As the categories become less and less inclusive, there will be variant kinds of each of them at successively lower levels. Thus, while there are only three kingdoms, there are at least twelve phyla, many classes, orders and families, and over a quarter of a million species of plants.

Utter despair at trying to grapple with this vast taxonomic system must have descended upon the reader by now. Be henceforth heartened by the thought that the horticulturist-gardener can disregard all categories but the genus, species, and possibly, as well, the family. Simply keep in mind that when you use a binomial like *Daphne cneorum* it is not a disconnected, unattached entity. It fits into a framework of the system through attachment to a family, an order, a class, a phylum and the Kingdom Plantae. And now, let us get back to scientific, botanical, Latin, binomial, nomenclature!

(To be continued.)

Palm house at Kew. **All photos: J.A. Witt**

Endangered Plants and Botanic Gardens

JEAN AND JOE WITT

Mail coming to the Arboretum office tends to be heavy with announcements of various meetings, conferences and symposia dealing with nearly every conceivable subject even remotely of interest to an institution such as ours. Normally these are filed away with little thought. However, in April, 1978 an announcement of a meeting at the Royal Botanic Gardens, Kew, England seemed worthy of further exploration. It gave details of a conference on "The Practical Role of Botanic Gardens in the Conservation of Rare and Threatened Plants" to be held that September, which was the follow-up of an earlier conference held three years before. Not only was the subject matter of the meeting of great interest, but the "price was right" since living expenses for an entire week would be slightly less than $160.00. There would also be an opportunity to extend our stay for two more weeks and visit a number of British gardens. The Unit Council was approached to see if they might finance the trip, and they generously agreed.

We left Seattle on Pan American polar flight for London on September 10 and arrived at Heathrow Airport about noon Monday the 11th, where we were met by a representative from Kew. He drove us to the Froebel Institute, a Teacher's college near the Botanic Garden, where we were housed in a dormitory built in the 17th century as a coach house. Here we began meeting various delegates, representing at least 40 countries, with the great majority coming from Europe as might be expected. Every continent was represented—except Antarctica—by at least several delegates either from botanical gardens or organizations devoted to conservation. North American representation was disappointingly small. Patrick Seymour from the Devonian Botanic Gardens, University of Alberta, was the only Canadian and was the official observer from the American Association of Botanical Gardens and Arboreta. There were five from the United States, six if Jean were counted, and one from Mexico. In total there were about 120 delegates.

The Conference

The formal sessions began on Tuesday in the Jodrell Laboratory at Kew and were held in a fine, small lecture theatre. Formal paper presentations continued for three and one half days and were divided into general topic areas. These covered such subjects as Background Information, National Policies, Information for the Public, Regional Conservation Schemes, and Cul-

tivation and Support Services. A number of short papers germane to each general topic area were read by authorities from various countries. Those which we found most interesting included the following: Professor H.B. Rycroft, National Botanic Garden of South Africa, on the role that institution plays in conservation of native plants in South Africa; J.B.E. Simmons, Kew, on the introduction and distribution of wild collected plants and how an established botanic garden may assist less well-developed gardens in preserving their native flora; E.E. Gogina, Main Botanic Garden, Academy of Science of the U.S.S.R., Moscow, on the main trends in conservation of threatened plants by botanical gardens in the U.S.S.R.; and a fascinating paper by Mr. A.P. Vovides, of the newly established Jalapa Botanic Garden, Mexico, on practical conservation problems of a new garden in the tropics.

There were several technical papers on cultivation, care and culture of rare and threatened plants. One paper which we shall always remember dealt with an attempt to reintroduce the natural vegetation on a sand-dune area in Southern France. The author presented a series of slides showing the progressive re-vegetation with rare plants of a much overused beach. It was evident that the experiment was highly successful until the last slide which showed a road and parking lot being constructed over the experimental area!

A recurring theme running throughout the entire conference dealt with the danger of extinction to certain elements of tropical and sub-tropical floras primarily the result of human activities. Botanical gardens in the tropics, with a few notable exceptions, are unable to be as active in the field of conservation as might be hoped, partially because of lack of interest and mainly because of lack of finances. While many of the larger institutions in Europe and North America are growing endangered plants in their conservatories and greenhouses, it is clearly evident that it will be impossible to save even a small percent of the threatened species from the tropics using these facilities. Obviously space limitations will preclude growing many endangered plants and, as energy for heating and cooling becomes more expensive, many gardens will have to cut back on their tropical collections.

The conference then divided into a series of work parties to discuss the problems and challenges posed by the meeting and to formulate a position paper which would summarize the feelings of the delegates. After much consideration and discussion, the following conclusions were agreed upon (these are paraphrased from the original):

I. That tropical floras are in great hazard. The conference urges that a network of nature reserves and conservation-oriented gardens should be established in the tropics, and that all countries should have a network of regional botanic gardens to supplement the nature reserves. Better developed institutions are urged to offer all possible technical assistance and training to aid developing tropical gardens and to establish fellowships providing reciprocal interchange of staff among the world's botanical gardens. It is suggested this activity be funded by "major multi-national and national corporations."

II. That the International Association of Botanic Gardens, now not a very active organization, should 1) become more active by promoting education, 2) encourage the propagation of rare and threatened species and their re-introduction to the wild, 3) promote the exchange of staff, 4) coordinate the exchange of information on current collections of botanic gardens and stimulate the development of special collections, 5) encourage formation of regional groups of gardens to exchange ideas and pool resources, and to establish a system of awards to stimulate the above. Interestingly enough the American Association of Botanical Gardens and Arboreta implemented much of this program years ago.

III. That international agencies devoted to the protection of wildlife become concerned with threatened plants rather than concentrating their interests only on animals and general habitats. They should also be asked to support botanic gardens which require help in conservation programs.

IV. That an organization be established to promote cooperation among botanic gardens on conservation matters.

V. That guidelines for collectors and leaflets to discourage casual and unrestrained collecting of plants be formulated and given worldwide distribution.

VI. Technical recommendations on plant collecting expeditions and the subsequent distribution of the collected materials will be published at a later date.

Royal Botanic Gardens, Kew

Part of one afternoon was devoted to a tour of the Royal Botanic Gardens which gave the delegates an opportunity to visit some of the behind-the-scenes work connected with that great garden. Joe visited their record center and found, as might be expected, a modern computer-based system of record keeping, but to be perfectly frank, it was no more efficient than our card files and nowhere as complete except for recent acquisitions. We must admit, however, they are working with perhaps three times the number of plants we grow, many of them located in their extensive ranges of glass houses. The wine and cheese "tea" that afternoon allowed us to mix with the Kew staff and proved to be one of the best parts of the program. We met and talked with delegates whom previously we had seen only in passing and were able to exchange ideas and suggestions—many unrelated to the conference topic. Along these same lines a commons room with soft chairs and a bar was open on those evenings which were not occupied with programs. By mid-evening there were little knots of people scattered about discussing mutual problems and solutions, ways of getting funding, great ideas seen elsewhere and the rest of the usual chit-chat. It is such informal gatherings of people with common interests but from diverse backgrounds which make conferences worthwhile.

Wakehurst Place and the Seed Bank

The last two and one half days were devoted to field trips to sites of conservation activities near London. Friday afternoon we were taken to Wakehurst Place, a garden belonging to the National Trust but now operated by Kew as a satellite garden. Wakehurst Place serves a double function, first as a beautiful garden away from the wretched soils and polluted air of Kew in the somewhat milder climate of Sussex south of London and, second, as a laboratory for the plant physiology section of the Royal Botanic Garden. It was the latter that was of the greatest interest to this conservation conference since the plant physiology section maintains Kew's great Seed Bank. The Seed Bank holds under highly controlled temperature and humidity conditions, some 5,000 different kinds of seeds collected from the wild or from cultivated plants, using in part a fine old 15th century house converted inside to

Wakehurst Palace built by Edmund Culpepper in 1590.

laboratory space. We were shown how the staff had developed techniques to preserve a wide range of seeds, many from threatened species. We saw great bales, bundles and sacks of uncleaned seeds drying slowly in controlled humidity rooms, later to be threshed, the seeds removed, packed in small lots and placed in refrigerated rooms where the temperatures were held either at −10°C or at 2° to 4°C depending on the species. At various pre-determined intervals small lots of seeds are removed and checked for viability; when too few seeds germinate, that lot is discarded and a new lot collected. Their experience indicates that about eighty percent of the seeds will still be viable after 15 to 20 years.

Obviously, such a storage unit is invaluable to those working toward saving endangered plants. It gives them a cushion of time in which to find suitable habitats where these species may be re-introduced and some leeway in finding how best to go about this. This is, of course, no great panacea which will save all threatened plants. First, many seeds can't be stored this way; second, there isn't enough room even with an extensive enlargement of storage facilities; and third, collecting seeds of certain endangered plants may only serve to reduce further their chances of survival in their natural habitat.

The Seed Bank is not the only conservation effort being carried on at Wakehurst Place. We

***Olearia albida* at Wakehurst.**

saw three other projects aimed at preserving wetlands, meadows and a forest park. Those of us from areas where much of our habitat conservation work is aimed toward lands relatively untouched by human activities had to rearrange our thinking somewhat since there is very little of the British Isles that has not been affected by man. The major conservation thrust at Wakehurst, as in many similar projects we saw, is to restore the British countryside approximately to those conditions that existed before the industrial revolution. Much of the lovely appearance of the English countryside is due to man-made landscaping developed by centuries of farming and grazing imposed on a fertile forested land with a mild and moist climate. There seems to be little or no effort to reconstitute the ancient forests that once covered much of the tight little island.

The visit to Wakehurst gave those of us who were attending the conference as horticulturists first and conservationists second an opportunity to indulge in garden viewing. The splendid old house and surrounding gardens have been run by the Royal Botanic Garden, Kew since 1965. Although many families had owned the property it was developed into a magnificent garden by Mr. Gerald Loder, who bought the estate in 1903, and by Sir Henry Price who bequeathed it to the National Trust in 1963. The garden of those two men has been maintained and enlarged by the Kew staff, and Wakehurst Place should be on the "must visit" list of all interested in good plants and good gardens. Despite the fact we were visiting in the autumn, we were pleased to find a good array of plants still flowering. Heathers—*Erica* and *Calluna*—in vast colorful drifts; *Eucryphia* in variety, late *Hydrangea* cultivars, *Hypericum* and several plants from the southern hemisphere such as *Grevillea sulphurea* were in their prime in sweeping beds on a west-facing slope. Nearer the house, a series of walled gardens were a riot of color with late summer perennials. We were reminded how well British gardeners use the lovely brick and stone walls with which they are so abundantly endowed. Wakehurst's climate is milder than London's, and we saw numerous trees and shrubs that are not really hardy in Seattle but which thrive in the southern third of coastal Oregon.

Away from the headquarters, the garden becomes less formal but no less interesting. Because of limited time we were able just to sample the wooded walks and valleys filled with rhododendrons and unusual tree species. We did see enough to know that the next time we would spend more than half a day there.

Sissinghurst Castle, Kent

The next day saw us "coaching" by bus to Kent to visit Sissinghurst Castle and the National Pinetum at Bedgebury. Since there seemed to be no conservation projects at the former, we concluded this was a treat scheduled for those primarily interested in gardens. Sissinghurst Castle is a relatively modern garden built around the remains of an Elizabethan house which, after numerous vicissitudes, was purchased in 1930 by Vita Sackville-West and her husband, Sir Harold Nicolson. These two talented people restored the old ruin to suit their needs, but it was Ms. Sackville-West who designed and constructed the series of small, individual gardens which make this such a fascinating place to visit. Divided by walls and hedges, each little garden has a distinct flavor. There is a rose garden, a cottage garden, herb garden, lime walk, and perhaps most interesting, a white garden with a wide array of plants with silver foliage and white flowers. We were impressed again with the use of walls for growing tender species and for creating spaces. Sissinghurst Castle is well endowed with walls, both new and old, and imaginative use of plant materials makes pleasing combinations of brick and stone, flower and foliage. Needless to say, the gardens are well manicured and should be, since they have a staff of two head gardeners plus six to nine others. Wow!

National Pinetum, Bedgebury

After lunching at the village of Goudhurst we were taken to the National Pinetum at Bedgebury. Originally established as an outplanting site for Kew in 1924, the National Pinetum is operated by the Forestry Commission, the British counterpart of our Forest Service. Located in the rolling sandy Kent countryside, it serves as a testing ground for new conifer species and varieties, as a display garden and as a collection for botanical study. The collection contains about 200 species plus another 200 cultivars all in about 100 acres. Bedgebury was originally laid out by Mr. W. Dallimore, a noted authority on conifers, who used the concept of long grassy avenues lined with tall evergreens. Despite rather poor soil

conditions, the trees have made more than adequate growth and are, as near as we could tell, thriving. There is a fine collection of Pacific Northwestern species, many planted in 1925 and now 80 to 100 feet tall, including Douglas fir *(Pseudotsuga menziesii),* grand fir *(Abies grandis)* and noble fir *(Abies procera).* Perhaps the most impressive grouping, however, was a broad "ride" running from a hilltop down into a shallow valley lined with many kinds of Lawson cypress *(Chamaecyparis lawsoniana).* It is a remarkable collection of diversely shaped and colored forms of this Oregon native, and demonstrates the plasticity which can be found in certain plant species. More exciting, however, were the more or less mature specimens of several southern hemisphere conifers such as *Fitzroya* and *Athrotaxis.* Both genera are growing in the Arboretum, but our plants are still quite small.

Bedgebury also has a number of forest plots where trees are planted in quarter-acre blocks, one species per plot; comparisons in growth rates and seed sources are made among the 100 species now being tested. Not all trees being tested are conifers; we were told there is one block of *Acer macrophyllum,* our bigleaf maple, that dates back to 1929. We should like to have seen these but time did not allow, and we were herded back on the coaches for the long return ride to London.

Thursley Common, Surrey

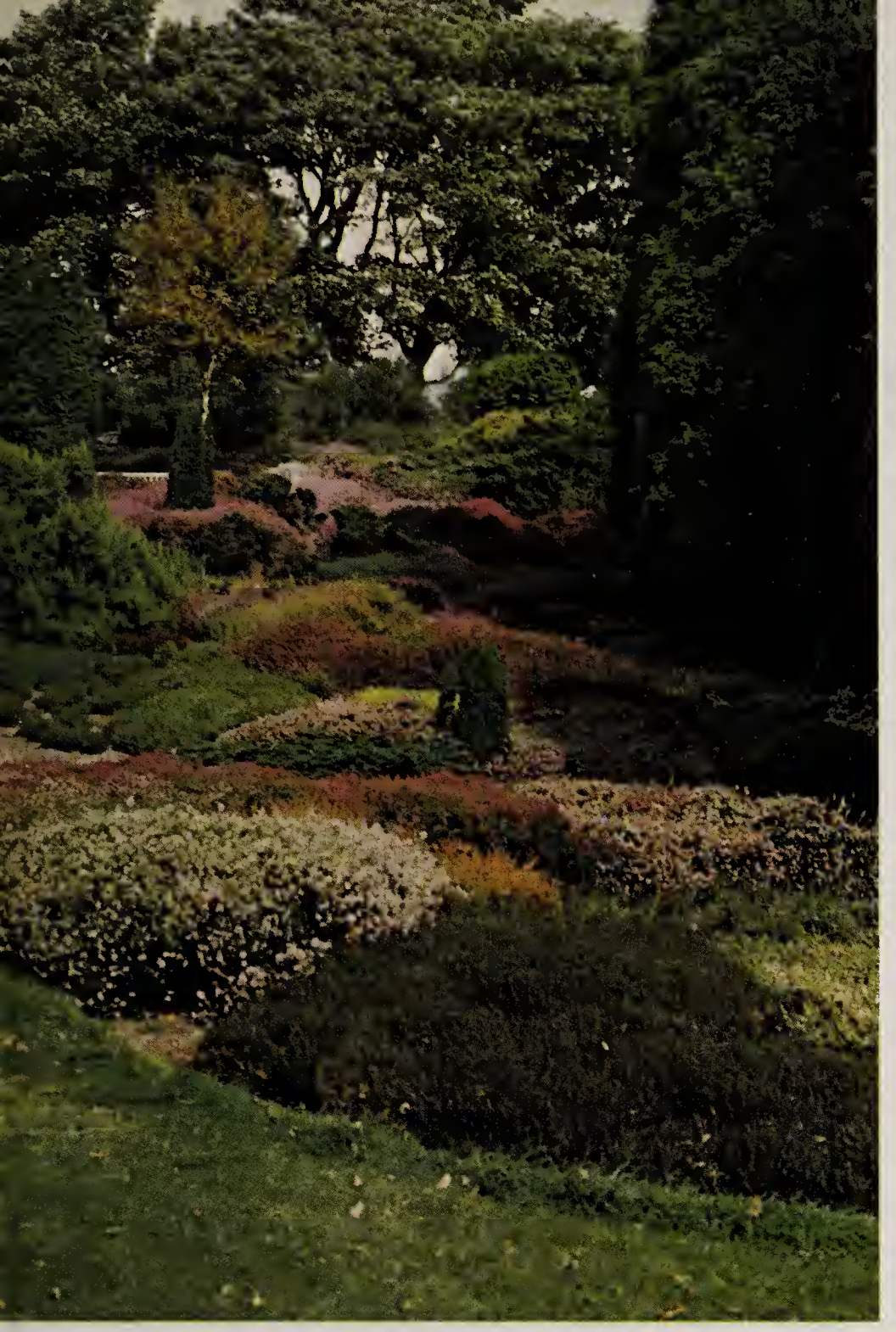
Sunday morning was the start of the busiest and most active day of the conference. We first visited a nature conservancy property, Thursley Common, near Aldershot in Surrey. Probably not more than 40 miles from the heart of London, this was the first "wild" area we had seen. Now a place of dry, sandy heathlands intermixed with bogs, it was formerly forested with broad-leaved trees such as birch and oak. Early man cleared the land, and continual grazing changed the character of the soil to the point where it became open heath. It is this man-made landscape that is now being preserved, the juxtaposition of wet and dry lands producing such a variety of habitats that many rare plants are found in the preserve. It is the numerous insects, however, that make the site unusual, with between 5,000 and 10,000 species thought to make this area their home. Fortunately we met only a few of this horde in our short stay, but we did see several plants commonly cultivated in our gardens growing wild. *Erica tetralix,* the cross-leaved heath, and *Calluna vulgaris,* heather, were flowering side-by-side.

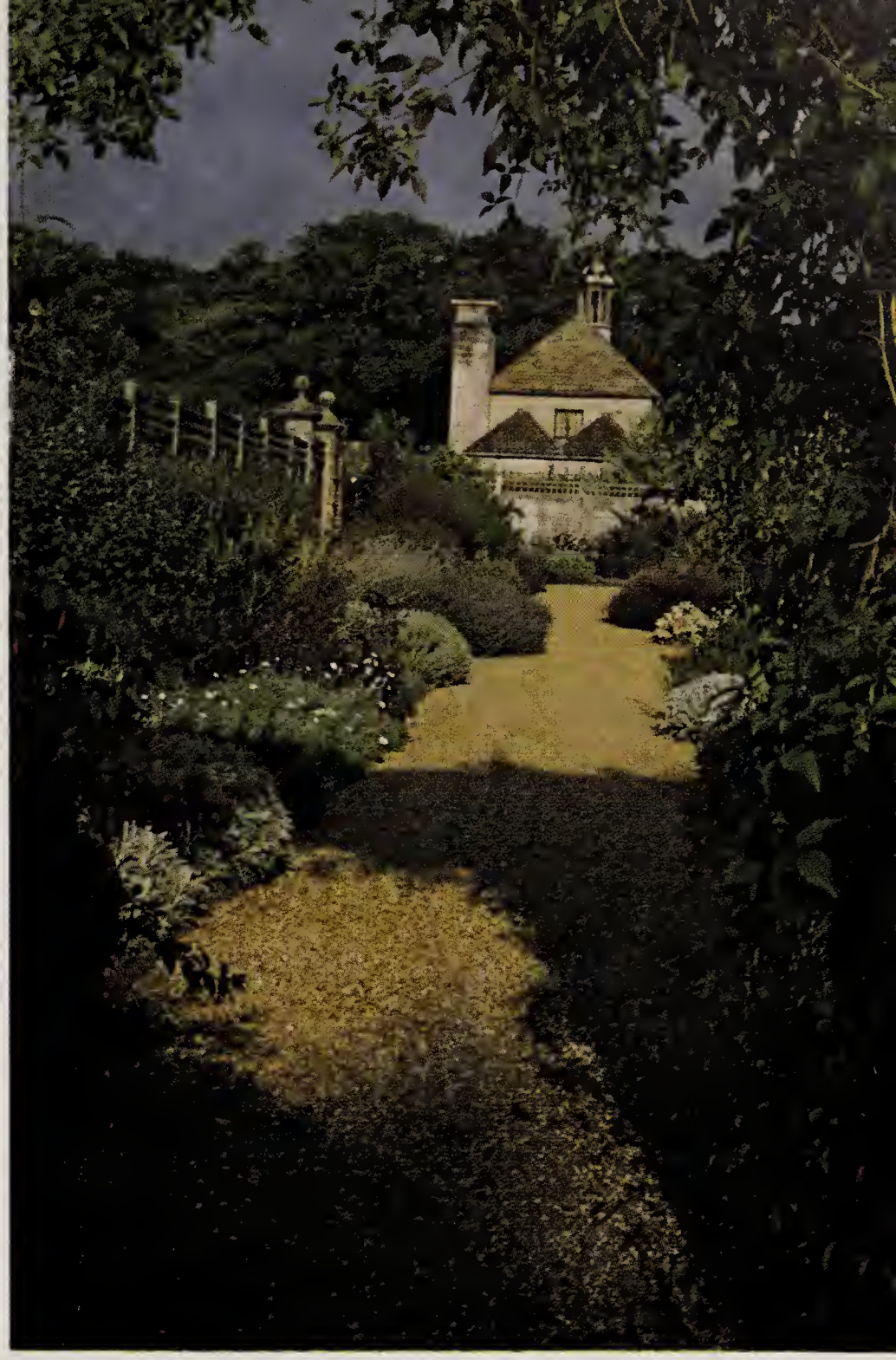
Kingley Vale, the South Downs

Leaving Thursley Common to the entomologists, we drove south, taking a shortcut that put our coaches on roads so narrow and so deeply embedded in hedgerows that on-coming traffic was forced to dart into driveways or back up. We were to remember this experience later in our trip when we were in a car and not the coach. Our destination was Kingley Vale, a small valley at the foot of the grassy hills known as the South Downs. A grove of English yew (*Taxus baccata*) of truly gigantic size and obviously centuries old grows on the limestone soil here. Our party was equally interested in the downs since these steep hills are the home of a number of rare plant species found only on the chalk. Here too grazing is a factor in maintaining an unusual ecosystem. The steep slopes and rounded tops of the downs above Kingley Vale are purposely grazed to maintain the grasslands; where sheep are excluded, brush and trees rapidly invade and destroy the unique flora. This is rather typical of a number of management techniques which the British are using to maintain their man-made landscape.

Queen Elizabeth County Park, Hampshire

Our third stop was Queen Elizabeth County Park, a large park belonging to the County of Hampshire. A short distance from Portsmouth and Chichester, the park has a rather startling array of features including demonstrations of sheepherding, forest crafts and ancient farming methods, as well as picnicking, grass skiing, hiking and other more traditional park uses. Our main interest was a replica of an Iron Age farm where archaeological studies are being conducted on crops raised by the pre-Roman British, and how they might have been grown and harvested. We were shown small plots of various vegetables and grains, some being currently cut with sickles, including three types of primitive wheat: einkorn, spelt and emmer. A large circular daub-and-wattle-walled house with thatched roof is part of the project, built to try ancient construction methods. Although this is obviously a popular site for park visitors, we were assured that its





Clockwise from top left: Sissinghurst, wall garden; Ness, heather garden; Wakehurst, purple and silver garden; Sissinghurst, Rondel (below) and priest's house with white garden (left), from the tower; Edinburgh, Royal Botanic Garden, the rock garden. All photos: J.A. Witt

primary purpose is scientific and that evidence gathered so far indicates that the Iron-Age people had a more than adequate diet and probably produced a surplus for exchange or trade.

Our return to London was the official end of the conference, and Monday morning saw most of the delegates saying their good-byes. Our taxi, called for 8 A.M., arrived at the Froebel Institute about 9:30, and we then spent an hour in the most horrendous traffic mess we had ever seen. It seems obvious that London will shortly be choked by its automobiles unless the gas shortage solves the problem. We arrived at the railroad station just in time to pick up tickets and rush aboard the next train for Edinburgh.

Royal Botanic Garden, Edinburgh

The next morning, Tuesday, was sunny and warm, so we walked from our hotel to the Royal Botanic Garden, Edinburgh, where we met Mr. Alf Evans, Curator of their famous rock garden, who introduced us to Dr. Henderson, the Regius Keeper. Jean visited their extensive herbarium to look at *Iris* specimens while Mr. Evans and Joe "did the garden." Little has changed since Joe's visit in 1966 except there are new display houses and a very new display of trough gardens and an alpine house. Stone troughs for growing alpines certainly are nothing new. These handsome carved tubs are an ideal way of growing tiny plants which require special soils and culture. However one sees them all too often sitting like rows of sarcophagi in a museum, full of beautiful plants but fitting into no landscape except perhaps a cemetery. These troughs at Edinburgh are arranged in groups on an open stone-paved plaza with ground covers around their bases, tying them to the stone paving. It is really a super solution to a difficult landscape problem.

Their glass houses are most innovative. One huge range has all its support placed on the exterior, leaving the inside free of posts and other supports, so there is little interference for plantings. Another successful idea is a display where ground-cover plots are divided from each other by low clipped hedges of various types, two for the price of one, in effect. The maintenance and culture of the vast array of living plants is impressively high, and is equalled by the tremendous herbarium collections housed in a beautiful and spacious building.

After a fling along Princes Street, we picked up a car and with great fear and trembling ventured forth to face the British driver. Joe clutching the wheel with sweaty hands and muttering "keep to the right, keep to the right," with Jean charting our course on the roadmap, we headed south. Actually, aside from an acute case of shattered nerves the first few days, we had no really difficult times during our 10 days of driving. We visited the Lake Country, then drove to Chester, a picturesque walled city famous for its Tudor buildings and double-deck shops. Chester is a few miles southeast of Liverpool, near the base of the Wirral Peninsula, and a good location for visiting Ness, the Botanic Gardens of the University of Liverpool. Mr. J.K. Hulme has written about Ness on the next page, so we shall limit our account in this article to saying that we enjoyed our visit to that garden as much as to any seen during our three weeks in Britain. (To be continued.)

Royal Botanic Garden, Edinburgh. Right, the stone troughs on the plaza; left, glass houses showing exterior supports.

The garden at Ness looking toward the estuary of the River Dee. All photos: J.A. Witt

Ness

The Botanic Garden of the University of Liverpool

J.K. HULME
Director

The Garden at Ness dates from 1898 when the late Arthur Kilpin Bulley built his house on a sandstone hill with views over the Dee Estuary and the Welsh Hills. The south-facing slopes were an additional attraction of the site because they increase the range of favourable positions for the cultivation of plants. Mr. Bulley was a keen naturalist and became interested in exploration to discover new plants for British gardens. He wrote to people working in many areas of the world asking them to send seeds of the plants they encountered. Some responded, but with far from encouraging results. "Ness," said Mrs. Bulley, "could claim to possess the best international collection of dandelions to be seen anywhere."

Mr. Bulley realized that the services of a specialist plant collector were required, and on the advice of Professor Isaac Bayley Balfour, Regius Keeper, Royal Botanic Garden, Edinburgh, George Forrest was commissioned to go out to western China. Seven years later, A.K. Bulley launched Kingdon-Ward on his career as a plant collector. A few years later he employed R.E. Cooper to collect in the Himalayan province of Bhutan. Siehe was engaged to collect bulbous plants in Asia Minor. Mr. Bulley also had shares in the expeditions of Reginald Farrer, Clarence Elliott, E.K. Balls and Goethe. Many of the newly introduced plants were cultivated at Ness. Mr. Bulley's seed and plant firm, Bees Limited, came into existence in Ness Gardens before being transferred to an extensive site at Sealand near Chester. Mr. J. Hope came from Edinburgh in 1913 to convert the original nursery area at Ness into ornamental gardens.

Ness is situated on the south side of the Wirral Peninsula which runs almost north to south between the Rivers Dee and Mersey. The moist southwesterly air currents approach us over the Welsh Hills where considerable precipitation occurs, placing Ness in a rain shadow. With an average annual rainfall of some 705 mm (28 in.), it ranks as one of the driest areas on the West Coast.

In comparison with the Cheshire Plain, we experience generally fewer and less severe

frosts. Mild spells in spring are fairly common. Some years ago we took an exhibit to the R.H.S. Halls, including quite a number of dwarf *Rhododendron* lifted from the open ground. A lady who spoke to me about these plants assured me they must have been grown indoors as hers "in Kent were still in tight bud." I couldn't explain to her we simply couldn't cheat—the plants we had lifted and placed indoors days earlier had passed their peak!

The site at Ness is very advantageously undulating with a sandstone promontory toward the centre and a sandstone slope at the northeast edge. The glacial drift toward the southern boundary is a calcareous heavy boulder clay; toward the north end of the site we have alluvial silt. The variety of soil conditions again increases the range of plants we can grow.

Apart from a small clump of sycamore and some hedgerow ash trees, the site was fairly open farmland when Mr. Bulley arrived. Rows of Lombardy poplar (*Populus nigra* 'Italica') were set to form the first defense against winds sweeping down the Dee Estuary from the Irish Sea. Within this belt holm oak (*Quercus ilex*) and at certain points Austrian pine (*Pinus nigra*) were used to provide shelter. A block of Scots pine (*P. sylvestris*) is a prominent feature in the Garden, but they are not so tolerant of coastal winds as some other species of pine. The Corsican pine (*P. nigra* var. *maritima*), the lodgepole pine (*P. contorta*), the Monterey pine (*P. radiata*) and the Japanese pine (*P. thunbergii*) are all performing well as young trees. For quick results in all but the most windswept areas, × *Cupressocyparis leylandii* has proved outstanding. The common holly *(Ilex aquifolium)*, Portuguese laurel *(Prunus lusitanica)*, *Escallonia macrantha* and various species of *Olearia* are notable shelter plants at Ness.

The Garden was originally developed in self-contained compartments, but the growth of the shelter trees has enabled us to implement a more integrated design. The urgency to develop on new lines arose from the fact that the Gardens were neglected during the second world war and then passed through a further period of uncertainty before the estate was presented to Liverpool University with a generous endowment by Miss A.L. Bulley to be kept as a Botanic Garden "as a practical and fitting tribute to the memory of her father."

The University, as well as installing elaborate control facilities for research, has supervised the extension of the Garden to include some 10 hectares (24 acres) previously let out as farmland.

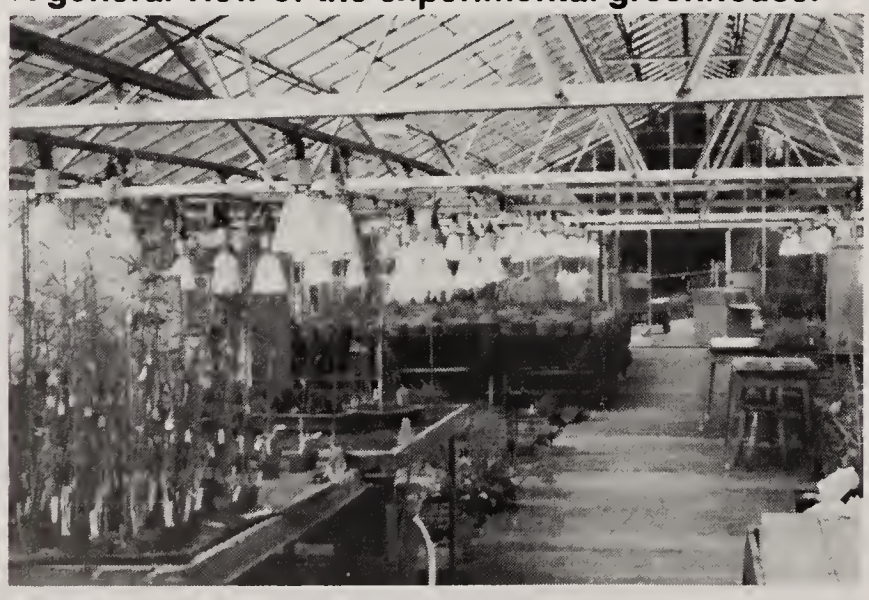
There is a series of glasshouses at the Gardens, some fitted with supplementary illumination equipment and one with mist-propagation facilities. Growing rooms at the Garden are used for raising seedlings in winter and for experiments which require constant conditions of light and temperature. Wind tunnels are available with controlled temperature and illumination for studying the effects of atmospheric pollution.

The modern gang mower has enabled us to plan long vistas and other broad sweeps of grass that are economically maintained. The availability of high-quality paving and walling materials has equally given us scope to plant in concentrated blocks with simplified maintenance.

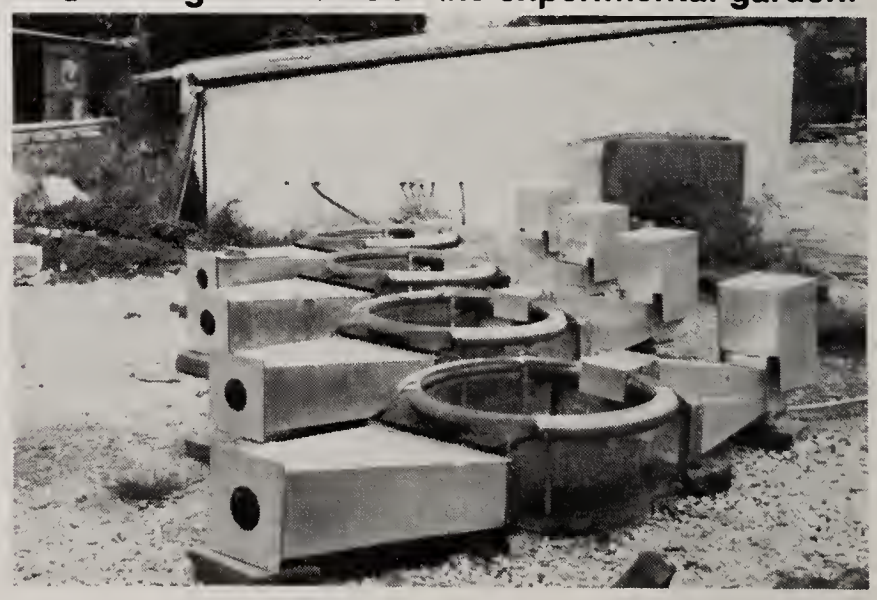
Recently developed weedkillers such as glyphosate and important residual herbicides like Simazine and Casoron G have been most valuable when extending the Garden to include previously neglected woodland or agricultural land colonized by couch grass.

Many notable plants survive from the original garden, including the specimen of *Pieris formosa*

A general view of the experimental greenhouse.



SO_2 testing chambers in the experimental garden.



Wall garden made of stone from old railroad station.

var. *forrestii* raised from the original seed sent from western China by George Forrest. There are also mature plants of *Rhododendron fictolacteum, R. roxieanum, R. hodgsonii* and *R. arboreum,* probably raised from Forrest's wild collected seed.

The principal attraction of the Garden is the very wide selection of trees and flowering shrubs. *Rhododendron* and *Camellia* are particularly well represented. In some seasons the earlier flowering hybrids and species provide a fine display in the first weeks of April. More frequently we see good blossom on *Rhodendron russatum, R. neriiflorum* and *R. oreotrephes* in late April; by mid-May *R.* × 'Damaris', *R.* × 'Loderi' and *R. cinnabarinum* attract attention; then toward the end of the month a crescendo is reached with *R. yakusimanum, R* × 'Hawk Crest' but more particularly with the massed plantings of azaleas. The standard cultivars are supplemented by many fine new hybrids raised by a former neighbour, Mr. M.C. Pratt. Azalea 'Elsie Pratt', named after his late wife, has strong pink flowers. We are delighted with a cultivar we propose calling 'Gold N' with large golden-yellow flowers borne in profusion and outstanding autumn tints in the foliage.

The *Pieris formosa* var. *forrestii* in a favourable season has sprays of pure white flowers shown against vivid scarlet foliage; none of the supposed named forms outshine the original plant. There is a fine old specimen of the handkerchief tree (*Davidia involucrata*) which regularly sets a good crop of seed; several 20-year-old trees raised from this plant have now settled down to flower regularly.

Flowering cherries and crabapples add greatly to the wealth of blossom in spring. Of the former, *Prunus serrulata* 'Shirotae' with pure white blossoms borne on horizontal branches, *P.s.* 'Tai-Haku' bearing creamy blossoms with bronze-tinted young foliage and *P.s.* 'Shimidsu-Sakura' with frilly pendulous white flowers revealing a faint pink suffusion are cited as favourites. The crabapples are represented by *Malus* × 'Golden Hornet' and 'Crittenden', similar to orchard apple trees in blossom and with coloured fruits in autumn. *Malus* × 'Lizet' has purple-tinted leaves and crimson flowers while *M. hupehensis* provides white blossoms when the others have lost their petals.

A *Laburnum* arch installed as recently as the mid-1970's is already a striking feature and attracts much attention in early June. The herb garden close by contains all the major culinary herbs, and visitors are often seen sampling the scents from these plants. Adjoining the herb garden we have established a section containing other aromatic plants such as lemon verbena (*Aloysia citriodora*), *Lonicera japonica* 'Halliana' and *Salvia elegans* (*rutilans*); all have an additional label in braille for the benefit of the blind.

The Rose Garden is arranged to demonstrate the history of the garden rose: starting with groups of European roses such as *R. gallica* and damask hybrids as they existed before being crossed with varieties from the far east; through the noisette

and bourbon roses, so many of which are superbly scented, leading to the hybrid perpetuals and on to the Hybrid Tea Roses and the hybrid floribundas.

A traditional English herbaceous border[1] is maintained, providing colour in June and July with *Dictamnus, Delphinium, Paeonia* and *Agapanthus.* In former times the herbaceous section was extensive with a series of borders laid out for seasonal effect. Many of the herbaceous plants are now used as ground covers around trees and shrubs.

In late summer the heather garden comes into its own. Set out on a magnificent hillside site, the cultivars of *Calluna vulgaris, Erica cinerea, E. tetralix* and *E. vagans* can be viewed with best effect. Our relatively mild winters allow full development of the tree heathers; *E. australis* is a notable spectacle in April with its masses of clear pink flowers. *Daboecia cantabrica,* the Connemara heather, thrives equally well including the less hardy pink-flowered selection, 'Praegerae'. On a dry site in full sun the foliage of many varieties in winter is often most colourful; *Calluna vulgaris* 'Robert Chapman' is outstanding with brilliant coppery-orange shoots.

In 1969 we began in earnest to develop a water garden. A typical Cheshire marl pool was cleared of native species in preparation for planting. At the same time two new polythene-lined pools were installed. All three were stocked with aquatic plants, most of which are growing to this day in the polythene-lined pools. In the pool with a puddled clay base, re-invasion with *Potamogeton* to the total eclipse of water lilies, et cetera, takes only a few seasons. At the edge of one of the pools a clump of terrestrial pitcher plant has survived since 1970.

In the same year we imported sand from the dunes at Ainsdale to create the effects of a dune-slack and collected the more interesting species from an area about to be developed as a holiday camp. The marsh helleborine (*Epipactis palustris*), the wintergreen (*Pyrola rotundifolia*), the wild orchids (*Dactylorhiza atrorubens* and *D. praetermissa*) have become thoroughly established in these conditions. In the higher and drier parts *Ononis arvensis* and *Rhinanthus minor* are equally at home. The striking grass-of-Parnassus (*Parnassia palustris*) fluctuates in numbers and appears at times to be on the verge of disappearing.

A more recent development has been the construction of a rock garden with a gorge separating tufa on one side and sandstone on the other. This is part of a native plant garden. In every instance the plants will be from a known wild location and some, already established, are threatened species in their natural habitat. The very porous limestone rock, tufa, is an excellent material in which to cultivate *Saxifraga caespitosa;* all the plants in this section were raised from seeds collected from a tiny isolated population. It has been possible to raise hundreds of seedlings, and some have been planted back in the valley whence the original seed was collected. A complete record of this activity is kept in order to be in a position to satisfy all points of view. Anyone wishing to carry out scientific work on this race of the tufted saxifrage can use the material at Ness. On the sandstone section are interesting native populations of *Erica,* and in a moist section at the base we have *Andromeda polifolia* taken from a bog about to be cut for horticultural peat.

The main rock garden is a short distance away and was developed on the site of a worked-out marl pit. The ground has been greatly modified over the years by the incorporation of a variety of materials, generally to improve drainage and aeration. Most of the rock used in construction was excavated from the main sandstone promontory in the Garden. Some limestone and a tufa outcrop have also been incorporated. In a rock garden covering two acres many shrubs and spreading perennials are used; the dwarf and slow-growing conifers are well represented. The compact small-leaf rhododendron are not particularly happy in the rock garden even in specially prepared pockets of peaty soil. They prefer the rapidly draining sandy soil on the hillsides. *Zenobia pulverulenta* is one member of the Ericaceae which does thrive in the rock garden. Its glistening white, pendulous, almost bell-shaped flowers are in evidence in mid-summer. There is a bulb meadow in the centre of the rock garden set with small populations of *Narcissus bulbocodium, N. cyclamineus* and *N. minimus,* as well as *Fritillaria meleagris* and the common snowdrop (*Galanthus nivalis*). Perhaps by raising the soil pH we will encourage the *Fritillaria* to

[1]The first example of this style of gardening was probably laid out at Arley Hall, Cheshire a generation before William Robinson planted his herbaceous border at Gravetye.

multiply. *Roscoea cautleoides* and *R. humeana* thrive in moist, rich soil toward the base of the slopes. In the damper positions we have maintained thriving populations of *Primula*, especially members of the Candelabra section. *Primula bulleyana* appropriately seeds itself around in all sorts of places. It has proved necessary to move the *Primula* plantings around the Garden since after several seasons the *Primula* sickness syndrome is manifest, that is, when a given position will support only debilitated plants and the normal growth of self-sown seedlings ceases to occur. Good stands of *P. florindae* are appreciated as much for their pleasant musky scent as their wealth of blossoms. It is interesting to note that few nurserymen in Britain offer for sale the Candelabra and Sikkimensis sections of *Primula*, yet they are so easily raised from seed. In the height of summer the "red-hot poker primula" (*P. vialii*) has immediate appeal with its pagoda-like inflorescence, bright red calyx and lavender corolla; it was first offered for sale by Bees Limited as *P. littoniana* in 1911. On the rock outcrops in the rock garden, *Campanula, Phlox and Saxifraga* provide colour in early summer. On the tufa section *Saxifraga apiculata* and its relations proliferate and provide welcome signs of approaching spring with their early flowers. *Anchusa caespitosa, Leontopodium nivale* and *Ramonda myconi* grow well on the tufa.

The erection of a series of terrace walls has enabled us to solve the problem of awkward slopes and provide favourable conditions for a range of less hardy plants. *Correa reflexa* (*speciosa*) has grown against the main terrace for more than 15 years and supports a succession of tubular pale yellow blooms throughout a mild winter. *Viburnum macrocephalum* produces its huge trusses of cream blossoms in early summer, and after a favourable winter we will see striking displays from *Leptospermum scoparium* 'Red Damask' and the lobster claw (*Clianthus puniceus*). The evergreen *Ceanothus* provide bowers of blue blossoms in early summer. Many informed visitors from across the Atlantic tell us the nomenclature of these plants in British gardens is utterly confused and someone should sort the group out. Perhaps a taxonomist of cultivated plants will one day come over and help us.

The sweet-scented rhododendron such as *R. bullatum, R.* × 'Fragrantissimum', *R. lindleyi* and *R. crassum* are set to be trained against the new terrace walls, along with *Tecoma radicans* and *Schisandra rubriflora*. A plant which has always excited interest on the terrace is the Mexican climber *Rhodochiton atrosanguineum*. It is raised each year from seed, set outdoors from pots in late May when it is already in flower, and will flower continually until the frosts set in. In 1978 it was still in bloom outdoors in December. The combination of colours—maroon-purple in the calyx, blackish purple on the outside of the corolla and satin black on the inside of the corolla—is most striking.

In an area adjoining the terraces we have set out a collection of dwarf and slow-growing conifers. The range of colour forms and different habits of growth of *Chamaecyparis lawsoniana* are represented. The glaucous foliage of *Picea pungens* 'Glauca' and the orange-gold shoots of *Thuja occidentalis* 'Rheingold' are often admired. There are green carpets formed by *Juniperus horizontalis* and delightful smokey blue prostrate plumes provided by *J. horizontalis* 'Douglasii'. One of the most impressive dwarf conifers we have is *Pinus parviflora* 'Nana'; in early summer the faintly glaucous shoots support collections of maroon male strobili.

1977 saw the completion of a new feature, The Queen Elizabeth II Jubilee Garden. The main paths are made of large Yorkstone slabs; the subsidiary paths are in sandstone sets. The soil at this point is on exceptionally well-draining sand which allows the cultivation of an interesting range of plants. *Clematis florida* f. 'Sieboldii' has survived the winter and provided a prolonged display of cream and purple flowers, which visitors frequently mistake for the blooms of *Passiflora. Tropaeolum speciosum* has become established and is spreading along the hedge. Old sandstone drinking troughs in the arrangement provide a suitable home for dwarf plants, including dwarf daffodils and hardy *Cyclamen*.

Postscript

In mid-September, 1978 we had the pleasure of spending a day at Ness. Perhaps it was the weather which was shirt-sleeve warm or maybe it was the fact that we had an easy drive from Chester, but whatever the reason Ness proved to be a highlight of our trip to the British Isles. First appearances are sometimes important in garden visiting; who can forget the imposing gates of

the Royal Botanic Gardens at Kew! Not so at Ness—our first view of this garden was of a drab, unpaved open parking lot which gave no hint of the good things beyond. We met with Mr. Hulme who spent the next several hours showing us through the gardens and answering our many questions.

Perhaps it would be best to avoid the usual tour descriptions and dwell on our impressions. First was the site. Gently rolling, much of the colorful parts of the garden looked down to the estuary of the river Dee and to Wales beyond. Great care had been given to framing vistas with carpets of heathers and groups of trees. The heather gardens were truly outstanding. One object we had in mind in visiting various gardens was to see how they handled plantings of *Calluna* and *Erica*. Nowhere did we see better use of these plants than in Ness, where color and foliage textures were most skillfully blended with each other and with their surroundings.

Research and ornamental horticulture existed side-by-side, neither detracting from the other. Their research program was quite broad: tests of weed-killers, trials of plants for air pollution resistance, studies of the taxonomy of *Sorbus*, and heavy metal testing on soils derived from mine dumps were a few of the projects we saw.

We were constantly reminded that this had been the garden of A.K. Bulley and that many of the truly magnificent old rhododendrons were original introductions by such great early 20th century plant colletors as George Forrest and Frank Kingdon-Ward. We also could sympathize with Mr. Hulme because Bulley didn't keep adequate records, and many fine plants had their collector's number lost beyond retrieval.

The west side of the Wirral Peninsula has a mild climate, somewhat drier than Seattle, and the range of plants growing at Ness was similar to those found in the Arboretum. As with many British gardens, south facing walls and a terrace provide that special warm site for vines and shrubs a little too tender to survive without extra protection. The walls were built into a hillside and were constructed of old building stone. They proved to be a real sun trap. We were fascinated to see the Mexican vine *Rhodochiton atrosanguineum* growing there since it is normally a greenhouse subject. Its bloodred bell-shaped flowers were most handsome seen against the warm sandstone wall in company with *Ceanothus, Clematis, Hypericum* and many other brightly flowered shrubs. What a delightful spot to sit in on a cool but sunny fall day!

Our overall impression of Ness was of a beautiful garden, well managed and showing imaginative planning but with great respect for the past. We were especially intrigued to see how well research programs and ornamentals can be blended when given proper thought and care. This bodes well for the future development of the Union Bay Arboretum. We can urge you to make the little extra effort to visit the University of Liverpool Botanic Gardens when you have the opportunity; and don't be fooled by the parking lot.

J.A.W.

***Rhodochiton atrosanguineum* growing on a sandstone wall.**

Scotch broom flower tripped by a bee, which is temporarily pinned down by the stamens. Photo: B.J.D. Meeuse

The Opening and Closing of Flowers

*B.J.D. MEEUSE**

An arboretum is much more than a collection of trees; we don't begrudge climbers such as honeysuckle and ivy their place in the sun, and an undergrowth of lovely flowering herbs is always welcome. Although the flowers of herbaceous plants have been the subject of most research on flower behavior, the knowledge so acquired is generally applicable to woody plants. It is, therefore, not totally out of line to devote some pages of our *Arboretum Bulletin* to the behavior of flowers.

THE REQUIREMENT FOR POLLINATORS

One might well point out that there are quite a few flowers that will not open unless some dramatic event takes place. Good examples are legumes such as gorse *(Ulex europaeus),* Scotch broom *(Cytisus scoparius)* and alfalfa *(Medicago sativa).*

When a heavy insect such as a bumblebee or honeybee lands on the keel of a "virgin" flower, this part of the blossom begins to sag; the column of stamens and pistil which lay hidden in the keel—straight and stiff as if confined by a straitjacket—jumps out like a jack-in-the-box, and the visiting insect will usually be powdered all over by a cloud of pollen. In the case of alfalfa, visiting honeybees soon develop an aversion to the explosions; they will learn to steal the nectar through a natural slit in the flower without activating the tripping mechanism, and pollination (with subsequent seed production) will not be forthcoming. For this reason, in vast regions of the United States and Canada alkali bees and leaf-cutter bees, which do not mind the explosions, have been "roped in" for alfalfa pollination. In Indonesia, Docters van Leeuwen (1954) found that the flower buds of certain mistletoes do not pop open unless the birds that are their natural pollinators first manipulate them with their beaks.

CLEISTOGAMOUS FLOWERS

Flower-opening will ultimately always occur in flowers of the explosive type as long as pollinators are present. However, this is not the case with so-called cleistogamous flowers (meaning "closed," from Greek *kleistos* = closed, and *gamous* = marriage). In the eighteenth century, Linnaeus was already familiar with flowers of this type; in fact he was the first scientist to study the effect of external factors on cleistogamy. Darwin (1877) listed 55 genera of plants displaying the phenomenon. It is far from rare in important crop plants such as cereals and legumes. It is downright spectacular in the genus *Viola,* violets; in no other genus has cleistogamy been studied so extensively.

Some species, such as *Viola odorata,* have two kinds of flowers. Early in spring one finds normal, large flowers; those formed later in the season are

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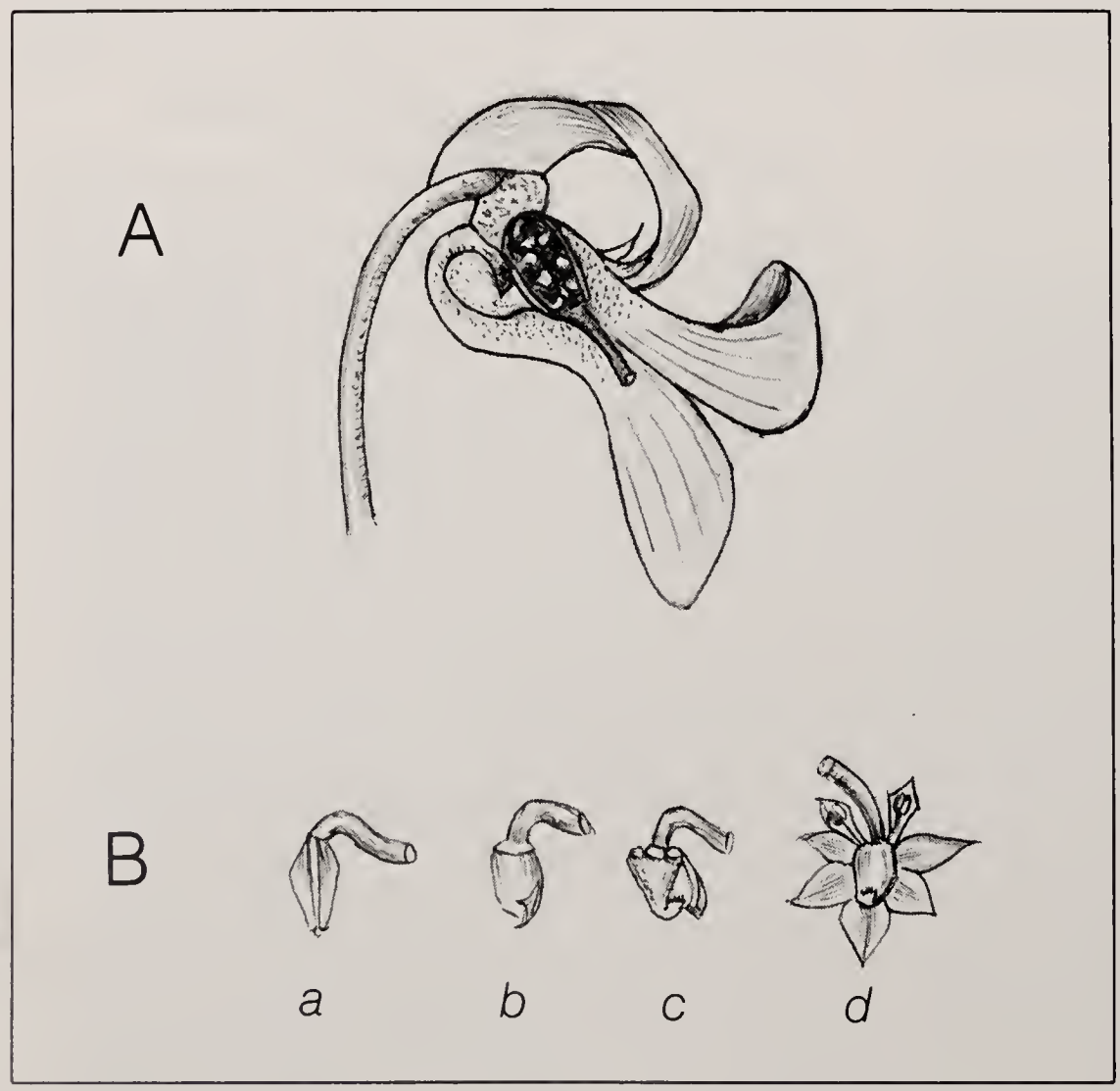
usually small and cleistogamous. A comparison of the two types shows that the large flowers, which possess a spur with a liberal amount of nectar secreted by two modified stamens, are adapted to pollination by long-tongued insects such as butterflies or bees. The cleistogamous flowers can be small because all the organs that are not directly involved in reproduction have been suppressed; consequently, the petals are tiny scales, and the lobes of the calyx are only one half the normal size. In some cases cleistogamous violet flowers have only two stamens instead of the normal five. The pollen grains germinate while they are still enclosed in the anthers. However, since these are pressed tightly against the stigma, the pollen tubes need only pierce the wall of the pollen sacs to reach the stigma. Effective self-pollination and, later on, fertilization of the ovules is therefore a practical certainty. The seeds formed in these cleistogamous flowers, although small in number, are quite normal and viable.

FLOWER RHYTHMS

Turning our attention now to those flowers around us that open and close normally, we cannot fail to be struck by the amazing regularity which some of them display as regards the moment of opening or closing. One is perfectly justified in referring to such flowers as *clock flowers.* Linnaeus (1763), assisted by his daughter, has given us a whole list of them; taken together, they can indeed be used as a "botanical watch." Probably the first person who tried to influence the behavior of clock flowers experimentally was A.P. de Candolle (1805). He was able to force flowers of four-o'clock plants (*Mirabilis jalapa*) to open at four A.M. rather than at four P.M. by a simple reversal of day and night.

Ecological Importance of Flower Rhythmicity

The opening and closing of flowers at a sharply defined time, and also the production of nectar and pollen at particular hours of the day, must be closely connected with the remarkable time sense of honeybees and many other pollinating animals. The upshot is that, in general, pollinators visit flowers at the time most advantageous for both plant and animal. In addition, clock mechanisms in flowers often effectively prevent self-pollination. A fascinating example is provided by *Silene nutans,* a moth-pollinated species whose fragrant flowers unfold in the evening. Each flower is open on three successive nights. During the first, it is male, displaying three of the six stamens. The following day, the flowers close again, but when evening comes they open anew, displaying a second set of three stamens (the first set has by this time shriveled up completely). After closing on the second day, the flowers then open for a third time, but now they are female; the three



The two types of viola flowers: normal chasmogamous flower (A above) and cleistogamous flowers (B below) of *Viola papilionacea*. In *a*, sepals are tightly pressed together; in *b* sepals are removed to show relative position of pistil and stamen; *c* is same, but stamen is raised; *d* shows sepals spread open with two stamens turned back from the pistil.
Drawing: B.J.D. Meeuse, adapted from Baird (1942)

styles forming the pistil have grown considerably in length and spread out their stigmas for the pollinating visitors.

Opening and Closing: The Biological Clock

The immediate question is: are regularites such as we have described due to some inborn, internal rhythm which is insensitive to the external circumstances, or do flowers react promptly to signals from the environment so that their behavior is more flexible? In recent years, botanists such as Bünning (1964) have brought convincing evidence for the existence in plants of "autonomous rhythms," often with a period of about 24 hours. In Anglo-Saxon countries they are referred to as circadian rhythms (from *circa* = about, and *dies* = day).

The "sleeping movements" displayed by the leaves of beans and other leguminous plants provide a classical example. When we germinate bean seeds in the dark and raise the seedlings in a dark room at constant temperature, the movements of the leaves are not very pronounced and certainly not synchronized when one compares the various young plants in one batch. However, after a single short illumination, the movements become both synchronized and more pronounced, and the plants show a marked rhythmicity in the sense that once a day a leaf returns to the same position—this in spite of the fact that these seedlings have never been exposed to a normal day/night regime! The movements persist for several days (although they gradually become less pronounced), and the 24-hour rhythm is maintained. *Clearly, there is a built-in biological clock.* However, acceptance of this idea should not blind us to the fact that the clock can be "set" or "adjusted" by a signal from the environment (such as the brief exposure to light in the case of our dark-grown bean seedlings).

ENVIRONMENTAL EFFECTS ON FLOWER OPENING

What makes the study of flower opening and closing (or *anthesis*) so fascinating is that the interaction between the internal rhythm and environment with its signals can vary so widely from one species to another. In some cases flowers follow our commands willingly, and the experimentalist can really "call the shots"; in others, the plant clings stubbornly to the rhythmicity which it already was displaying at the start of the experiment. Furthermore, since different plants may live in very different environments, to which in the course of evolution they have become beautifully adapted, we can *a priori* expect that not all flowers will react to the same environmental signals: some will respond to a change in temperature, others to the particular light/dark regime, and still others perhaps to a change in humidity.

Influence of Temperature

Most of us know that some flowers respond to a rise in temperature by opening; if, later, the temperature drops again, they will close. The best-studied plants in this category are crocuses, tulips, a flax species (*Linum catharticum*) and the winter aconite (*Eranthis hyemalis*). For all four, it has been shown that light has very little effect on opening and closing. However, the temperature sensitivity is most impressive. In his classical studies, Wilhelm Pfeffer (1873) showed that in crocuses a temperature rise of 0.5°C is enough to induce flower opening; with sophisticated modern equipment one can demonstrate that actually a 0.2°C shift is enough. Tulips are not quite as delicately attuned and require a rise of a full 1°C. Some flower species retain this ability to react to heat over a long time span—up to 12 days in the case of *Crocus sativus*.

This observation might lead to the idea that flower opening is a very simple affair, brought about perhaps by a change in turgidity of certain cells of the sepals or petals. However, amazing though it may seem, Pfeffer showed very convincingly that a growth phenomenon—a non-reversible change—is involved in these *thermonastic* flowers (those that respond to

Crocuses opening progressively as the temperature goes up. **Photo: B.J.D. Meeuse**

temperature). A sudden temperature rise causes the tissues on the inside of the sepals to start growing very rapidly, while those on the outside display a much weaker reaction; the result, inevitably, is flower opening. A drop in temperature has exactly the opposite effect, because now the cells on the outside begin to grow faster, while those on the inside show hardly any reaction. From Pfeffer's observations and experiments it follows that at the end of its blooming period a thermonastic flower is considerably larger than it was in the beginning. By watching the flowers of *Eranthis hyemalis* day after day in early spring one can easily convince oneself that Pfeffer was right. He also found that the temperature rise is only effective as long as one does not surpass a certain maximum temperature, which for *Crocus* is 27° to 29°C, for tulip 30°C. Heating up beyond this point leads to closing. Once the closing movement has begun, it cannot be reversed by bringing the flower back to a temperature slightly below the maximum, even though normally the flowers would have opened there.

In *Crocus* flowers, the region with the strongest growth response is at the base of the tepals occupying about $^1/_6$ to $^1/_4$ of a sepal's total surface area. In tulips, the region is not so well defined. The central cell layers of the tepals play the main role in the uneven growth; upper and lower epidermis have only a minor, regulatory function.

One of the most striking examples of a temperature effect on the development of flowers is that of the Indonesian pigeon orchid, *Dendrobium crumenatum*. The fragrant flowers, snow-white and yellow, are open only for a single day. However, the species compensates for this potential disadvantage by massive simultaneous flowering of all the plants in a given area. A possible biological advantage of this strategy is that certain social bees such as *Apis indica* rapidly develop flower constancy toward the pigeon orchids, visiting the flowers in droves. Abundant seed production is practically certain. It has been demonstrated that the plants produce flower primordia continuously, but these develop only up to a certain point and then go into a resting phase. One could say that they are just "waiting" for the right stimulus from the environment to really take off. That stimulus is a sudden drop in temperature, usually brought about by a severe rainstorm after a period of drought. Following the shower, about nine days are required to reach the flowering stage. A similar influence of a sudden temperature drop has later been found in *Dendrobium nobile,* a species that is often cultivated in greenhouses.

Influence of Humidity

Pfeffer found that raising the humidity had little or no effect on the opening of flowers, with the possible exception of certain evening primrose species (*Oenothera*), where it seemed to be promotive.

One of the very few cases where the influence of humidity on the development of flower primordia has been studied with sufficient care is that of the coffee plant (*Coffea*), where the formation of such primordia is initiated by exposure to short days. Under relatively dry circumstances, a rapid and uniform flower opening takes place only after a heavy rainstorm or after sudden inundation. However, this observation requires critical interpretation: in those cases where one drenches the coffee plants regularly (about once a week), the appearance of open flowers is delayed for a long time and sometimes indefinitely. This may well mean that the factor which is *really* responsible for breaking the dormancy of the flower buds is not the moisture *per se,* but the preceding drought. The application of water simply creates or maintains the conditions favorable for the development of the buds which have already been activated. It can be expected that this type of regulation, which involves drought and leads to flowering in a particular season, is rather widespread in tropical plants. Conceptually, one can compare the water-effect with the influence of the factor heat (that is, warming up) on the development of the buds in plants of temperate regions; the effect is not really due to the temperature rise but to the preceding conditioning of the buds by a different factor, in this case low temperature.

Influence of Light and Dark

There are good reasons for considering the factor light (broadly defined) as the most common regulatory factor for all sorts of flowering phenomena. However, stubborn endogenous rhythms will often make themselves felt as well. This was brought out beautifully by the work of Overland (1960) with *Cestrum nocturnum,* the famous *dama de noche* of Spanish-speaking tropical countries. The flowers open and become

fragrant in the evening. Although closed in the daytime, each flower remains active for at least a week. In constant darkness or constant light, the periodicity persists! On the other hand, the so-called queen-of-the-night cactus (*Selenicereus grandiflorus*) shows clearly how susceptible to change endogenous rhythms can be. By reversing day and night, one can force the flower buds to open in the morning, rather than at their customary hour in the evening.

A similar situation obtains in certain evening primrose species. There, it is interesting to observe that those flower buds opening during the two days following upon the switch to the new light/dark regime, will still do so at their old accustomed hour. This is an important observation because it indicates that the opening of flower buds, contrary to what one might intuitively suspect, is *not* a simple act but one that is very carefully programmed; two days before opening, an evening primrose flower bud is already committed to a certain course of action, and it does not make much difference what one does to the light/dark regime after that. Furthermore, the plants cannot be forced to accept just any cycle of light and dark. Put on a regime of alternating 24-hour periods, they refuse to let the flower buds open just once per 48-hour time span; likewise one cannot impose a 12-hour rhythm upon them by giving them alternating periods of 6 hours' duration.

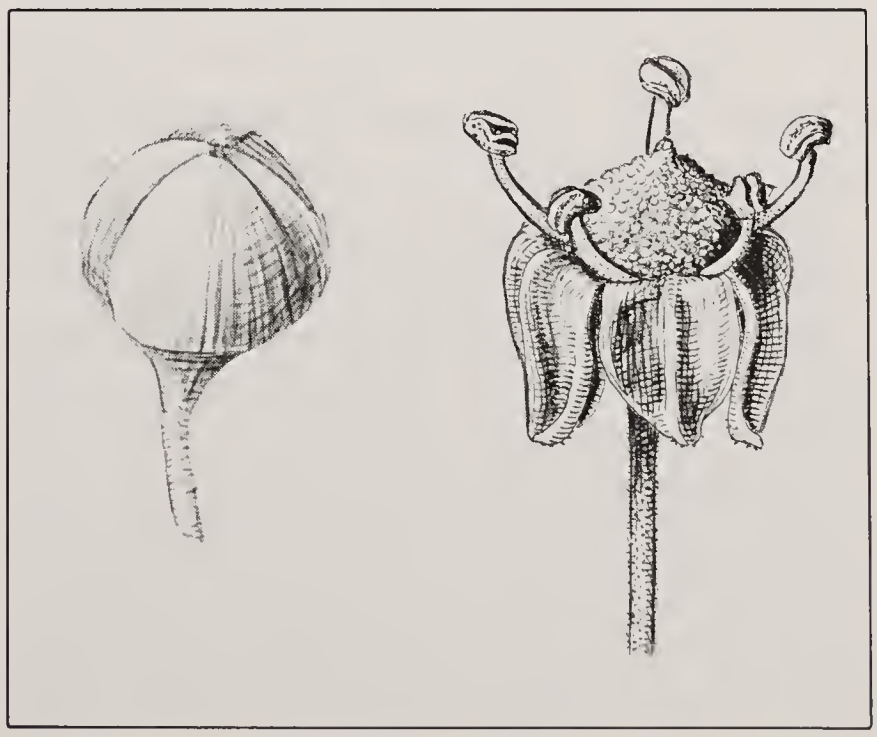
Among the most inviting targets for work on the influence of light and dark in flowering plants are the western European arum lily *Arum maculatum* (lords-and-ladies) and its close relatives, such as the voodoo lily (*Sauromatum guttatum*). In nature, flowering is clearly synchronized; the inflorescence of lords-and-ladies, for example, opens in late afternoon, and the so-called appendix (the sterile, naked upper part of the spadix) reaches a peak of heat production accompanied by an atrocious odor in early evening. An inflorescence allowed to develop in constant darkness will never open and produces neither heat nor odor. Inflorescences that have grown up in constant light will—ultimately!—open and produce some heat and smell, but the peak may now come at any time of the day or night. Reversal of day and night leads to normal flowering, except that the peak now comes early in the morning, roughly 12 hours earlier (or later) than under normal conditions.

Dendrobium nobile. **Photo: B.J.D. Meeuse**

The following experiment is very revealing. When voodoo lilies are allowed to develop in constant light until one is sure that they are beyond the point where flowering would normally have occurred, and one now imposes a period of darkness of at least 6 hours, the metabolic explosion which underlies the production of heat and smell will follow 42 to 45 hours (almost two days) later. This experiment should be seen in connection with the evening primrose experiments we have already mentioned; it confirms beautifully that *flower opening is not a simple event but one that is carefully programmed* so that roughly two days before opening time the flower or inflorescence is already committed. For both *Arum* and *Sauromatum,* the period of darkness which one inflicts after long-lasting illumination *must* exceed a certain critical length.

Common English ivy (*Hedera helix*) provides another excellent example of such a requirement because the opening of the almost spherical flower buds is sudden and almost explosive; they literally pop open, and the moment at which this happens can of course be determined with great

Bud and open flower of English ivy. Drawings: Hilda Kern and the author



accuracy. Sigmond (1930) demonstrated that, once a bud has reached the right developmental stage, a single "long night" of 6 to 6½ hours will do the trick; if it is shorter, the flower buds do not open the next day.

As to the famous four-o'clock plants, it was found in the early 1920's that one can very well raise them in constant light, all the way from the seed to the flowering stage. However, the flower buds which seem ready to open drop off *in toto* instead, after formation of a corky abscission layer in the flower stalk. This sort of shedding can be prevented, and normal flower opening can be ensured by imposing a short period of darkness. It has also been known for a long time that in our area, in the summer, four-o'clock flowers do not open at four P.M. but later. This behavior is determined by the moment of sundown; the flowers start "counting the hours of darkness," so to speak, when the night begins.

FLOWER OPENING AND FLOWER FORMATION—A COMPARISON

All these observations make it tempting to compare the behavior of flower buds and that of so-called short-day plants, which more correctly should be called long-night plants. If, in the latter, flowering is to occur (and flowering here means the induction of flower primordia), they must be kept on a light/dark regime in which they receive every day a period of darkness (a "night") which exceeds a certain length. If the long night is interrupted even by a brief period of light—and particularly red light—the formation of flower primordia is interfered with. However, in a number of cases at least, this disruptive effect of red light (wave length: 670 nanometers) can be annulled by subsequent exposure to far red light (wave length: 730 nanometers). It is now well known that the particular pigment which is instrumental in this matter is *phytochrome,* a bluish substance which can exist in the plant in two forms that are reversible to each other—one absorbing especially the red rays (and thereby changing into the other form) and one absorbing especially the far red (and thus converting itself back to the red-absorbing form).

Could it be that, at least in some flowers, the phytochrome system is involved in the opening of the buds? The case which so far has provided the best fuel for this theory is that of the tropical plant *Turnera ulmifolia,* studied extensively by N.G. Ball (1933 and 1936) on the island of Ceylon (now Sri Lanka). Normally, the *Turnera* flowers open about two hours after sunrise; three or four hours after that, they begin to wilt. The groups of buds that succeed each other, day after day, all behave in the same fashion, even when the flowering branches are kept in constant darkness for several days. This shows that there is a pronounced daily rhythm. Illumination during the night, especially when given during the small hours of the morning, prevents flower opening. Experiments with light of various colors showed that red is the most disruptive and blue light the least. This would definitely seem to imply the phytochrome system! Reversal of the red effect by far red has not been tried. Ball was years ahead of his time, and when he performed his experiments the phytochrome system was not even a gleam in somebody's eye.

OUTLOOK FOR FUTURE RESEARCH

It is clear that plant physiologists should begin to pay more attention to "ready-to-go" flowers (flower buds) in their studies of the phytochrome system. Using them offers advantages over the conventional method of flower induction, which requires a much longer period. At the same time, the fact that certain flowers and inflorescences, such as those of voodoo lilies and evening primroses, require a two-day preparation period for the buds to open, gives us a foot in the door if we want to find out more about the biochemical processes that are actually involved. It is quite probable that certain enzymes must be synthesized, a time-consuming process which, in its turn, depends on the activation of certain genetic factors that were lying dormant.

A second important point is that, indubitably, there is a connection between photoperiodicity and thermoperiodicity. For example, under the conditions prevailing in western Europe, the older commercial varieties of strawberries are strictly short-day plants. In northern Sweden, however, they flower abundantly even under long-day conditions, the reason being that the low temperatures to which the plants are exposed during the growing season abolish the short-day requirement. Similarly, it has been demonstrated that the production of tubers by potato plants grown at relatively high temperatures requires short days; in the Netherlands and Ireland, however, where the nights are cool, potatoes are produced at the end

of the summer even though the plants then have experienced only long days.

It is likely that such interactions between the light regime and the prevailing temperatures play a role also in the opening and closing of flowers.

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Summer Pruning

BRIAN O. MULLIGAN

In the Pacific Northwest the best time of the year to perform this useful work is from late June to the end of August. By that time the growth of most woody plants will have been completed for the year.

Take a pair of sharp shears and walk around the garden, looking first for the spring and early summer flowering shrubs such as forsythias, kerrias, spiraeas, deutzias and the earlier mock oranges *(Philadelphus),* our native red flowering currant *(Ribes sanguineum)* and the Indian plum, formerly well known as *Osmaronia* but now unfortunately changed to the less euphonious *Oemleria cerasiformis.* If possible remove completely those branches which have flowered this year and have younger ones to replace them.

Then look at any hollies, English or Portugal laurels (*Prunus laurocerasus* and *P. lusitanica* respectively), camellias, evergreen cotoneasters and the larger rhododendrons, especially the hybrids. Are they now occupying too much space and crowding their neighbors? If so, don't hesitate to cut back offending branches as far as necessary, though not into bare wood in the case of the camellias and rhododendrons, but to visible dormant buds. With old lilac bushes, take out partially or entirely one or more of the oldest branches each year to gradually rejuvenate the plants. This will require a saw since the wood is hard and heavy.

There may be small trees such as mountain ashes (*Sorbus* species or hybrids), dogwoods, magnolias, stewartias, *Styrax japonica,* or certain conifers especially the true cedars (*Cedrus* species), pines or hemlocks (*Tsuga* species) extending their branches too far laterally; these can now be shortened back to an appropriate smaller branch.

Plants espaliered on walls or fences, including fruit trees, should have their principal branches thinned to about six to eight inches apart, shortening back the remaining smaller ones to one or two inches. With young fruit trees of all kinds, look for and remove crossing branches, sucker growths on older trees, or those arising from the rootstocks on which they have been grafted. This last advice also applies to any trees or shrubs which are propagated by grafting, including *Hamamelis* species and hybrids, roses, rhododendrons, cherries and crabapples, magnolias and filberts. Dig out all such unwanted growths completely, taking care not to wound the stem of the parent plant while doing so. Finally, remove all unwanted seed capsules from rhododendrons and azaleas, lilacs and, if possible, the highly poisonous green pods of laburnums. ♠

Book Reviews

Books reviewed in the Arboretum Bulletin *are usually available for use at the Arboretum library. Readers are reminded that books may be purchased with a 10 percent discount through the Arboretum Foundation Book Committee (Loretta Slater [206] 232-0456).*

THE ENDEMIC FLORA OF TASMANIA, Part VI. Text by Dr. Winifred Curtis, illustrations by Margaret Stones. Ariel Press, London, 1978. Price £75.

This is the final volume of this superb folio-sized work on the endemic plants of Tasmania, which was envisioned and largely carried out by the late Lord Talbot of Malahide Castle, County Dublin, Ireland. Fortunately his sister, the Hon. Rose Talbot, wisely decided to complete it after his sudden death in May, 1973, when Part IV had not yet been published.

The first volume appeared in 1968, illustrating 37 species. By 1975, Part V included 40 more, and this last volume adds another 55 for a total of 254 plants of all kinds. They range from trees to montane cushion plants, representing 54 families including one of ferns (Gleicheniaceae) and three of gymnosperms (Podocarpaceae, Cupressaceae and Taxodiaceae). The largest number of species is found in Epacridaceae (*Cyathodes, Epacris, Richea,* et cetera, relatives of the Ericaceae of the northern hemisphere), and Compositae (*Olearia, Helichrysum, Senecio,* et cetera), followed by Myrtaceae (chiefly species of *Eucalyptus*). It is most regrettable that so few Tasmanian plants are known or grown in the Pacific Northwest since many appear to have real horticultural value especially for their flowers but sometimes also for their decorative, colored fruits. The climates are not so extremely different but the soils may be, and this could be one of the limiting factors until more is known of their requirements.

This part includes a foreword by the Hon. Rose Talbot giving her reasons for continuing with the work and acknowledging her debt to so many persons who helped to make it possible: the collectors in Tasmania, the recipients at Kew where specimens were sent for the artist to work on (and sometimes also to be propagated thereafter), the printer in West Germany, the publisher in London, but most especially the artist, Margaret Stones, and the botanical author, Dr. Winifred Curtis, in Tasmania. This is indeed a most notable example of what careful and well-organized cooperation between enthusiastic, energetic amateurs and a highly competent artist and a botanist can accomplish in a limited but important field. I do not know of any other botanical work on such a magnificent scale, dealing solely with plants found only in one country or a subdivision of it. Perhaps it may now become a forerunner in this class and prove an excellent model for others to follow.

One or two plants are depicted on each color plate. On the facing page is a short but adequate description of principal characters, with notes on habitat, abundance or otherwise, where the specimen (or specimens) was collected, when and by whom. The color reproduction is of the highest quality, and in most examples enlarged dissections of the floral parts are accurately shown as well as individual leaves.

In earlier volumes Lord Talbot added notes on how some of these plants were behaving in cultivation both in Tasmania and in other parts of the world—especially in the British Isles but also a few in the University of Washington Arboretum, Seattle. In Part V this information was continued by Mr. John Simmons of Kew, with some additional data on propagation. Part VI concludes with a complete list of all the plants illustrated in the six volumes arranged by families, as well as an alphabetical index to them and another for this part alone. These are necessary adjuncts since the plants in each volume are all arranged by families according to Dr. Curtis' *The Student's Flora of Tasmania* (Vols. 1-3, 1956-1967) and not alphabetically. Another excellent and useful feature is the double-page relief maps which form the end papers, showing all the principal towns as well as the physical features.

In sum, this is a major work of great botanical value both for the island state of Tasmania as well as for all persons interested in or trying to cultivate some of its remarkable and often beautiful flora. In addition, the books themselves are works of art and will remain such for many generations to come, treasured by those who appreciate and enjoy them.

BRIAN O. MULLIGAN

A SKETCHBOOK OF SANTA BARBARA'S NATIVE WILDFLOWERS. Text and sketches by Jacqueline P. Broughton. Santa Barbara Botanic Garden, Santa Barbara, Ca. 1977. Price $15.

Each spring, Southern California has truly spectacular displays of wildflowers. The month of April, usually mild and balmy, is the most rewarding time to see them in the Santa Barbara area. Bouquets of bright-colored wildflowers cling to the hillsides and cover the desert flats. It appears as though seeds had been scattered by a magic wand as, overnight, the yellow *Coreopsis,* California poppy, purple sage and *Clarkia* come to life. In the meadow Section of the Santa Barbara Botanic Garden, Nature puts on a colorful show! With the foothills of the Santa Inez Mountains as a backdrop, a living scenario is being enacted. At the Botanic Garden, visitors may identify flowering plants seen growing in the wild and purchase wildflower seeds.

The *Sketchbook of Santa Barbara's Native Wildflowers* in descriptions and drawings brings the copious plant material of the region into focus. The drawings, principally from living specimens, have supplemental references to color slides. The author shows great skill in describing each flower and its background story. In the Introduction to her book, the author, longtime staff member of the Santa Barbara Botanic Garden, says "...the real joy of wildflowers is in finding and studying them in their native habitats. Wildflowers should be left in place for others to enjoy; they should not be picked."

A few of the many native wildflowers described in the book are my special favorites. I have quoted below from the descriptions of those that have been of special interest to me as I have, early each spring, walked through the Meadow Section of the Garden.

Eschscholzia californica: "California Poppy, our state flower, with its bright orange petals, is found in most parts of California...Since 1832, when David Douglas introduced California Poppy into English gardens, a wide variety of colors...has been selected for cultivation."

Lupinus succulentus: "The several species of lupine found in the immediate Santa Barbara area are

recognized by their palmate leaves and spikes of blue or purple flowers... Today lupines are commonly cultivated for their ornamental flowers and a wide range of colors has been developed."

Erysimum capitatum: "Western Wallflower is a beautiful and highly variable perennial plant... The flowers, in dense terminal heads, range in color from yellow to orange to brick-red to maroon. However, the plants in any given location are all the same color... a North Temperate genus of about eighty species ... Wallflowers have long been used in gardens to produce colorful, long-blooming borders."

Clarkia deflexa: "Clarkias are slender annuals that bloom in late spring and have pink or lavender flowers... About thirty kinds of *Clarkia* occur in California... [the genus] was named in honor of Captain William Clark of the Lewis and Clark Expedition..."

Rosa californica (California Wild Rose): "The pink flowers, present from May to October... have a mild and pleasant fragrance and develop into bright scarlet fruits about half an inch in diameter."

Castilleja affinis (Indian Paintbrush): "A brilliant splash of red on a dry wooded or chaparral hillside often announces the presence of Indian Paintbrush, one of our most elegant wildflowers... [it] would appear to be a perfect subject for gardens but will not survive under cultivation since it is partially parasitic on the roots of other native plants."

Solidago californica (California Goldenrod): "The foliage is grayish-green in color... The bright yellow flower heads are small but numerous... The flowers of Goldenrod are a striking and familiar sight across North America in the late summer and fall. In fact the continent was once described as a land of asters and goldenrods."

Californians are more and more concerned with preserving wildflower areas. One can wend oneself toward patches of color by car and eventually, on foot, reach this annual display of fleeting beauty.

This attractive volume is published in a limited edition of 500 copies and is one of the Santa Barbara Bicentennial Historical Series. It may be ordered through the Santa Barbara Botanic Garden.

ROSAMOND P. ENGLE

Announcements from the Unit Council

Officers for the coming year are:

- General Chairman, Mary Ellen Mulder (new)
- First Vice-Chairman, Membership, Doris Taggart (continuing)
- Second Vice-Chairman, Education, Molly Wolfe (new)
- Third Vice-Chairman, Greenhouse, Mary Sambrook (continuing)
- Asst. Greenhouse Chairman, June Skidmore (continuing)
- Secretary, Pat Moncini (continuing)
- Finance, Carol Simons (continuing)
- Asst. Secretary, Sharon Goedecke (continuing)

The Second Annual Horticulture Exhibit was held March 29 and 30 at the Museum of History and Industry with 30 participating units. Unit awards were: Most Interesting Plant Material, Unit 84; Most Artistic, Unit 29; Most Educational, Unit 19; Best Grooming, Unit 64. Fifteen individual awards were given for outstanding specimens. Judges were Bob Badger, Marge Baird, Bill Hatheway and Jean Witt. The Arboretum and the Carl S. English, Jr. Gardens both arranged outstanding displays.

Chairman Ruby Williams says the colorful, fragrant exhibit attracted over 800 visitors. Bellevue Community College landscape classes came for study, and several groups of retirement home residents were brought by van.

The education committee will be sponsoring a series of cutting parties during the summer for those who wish to learn this means of plant propagation or obtain new plant material for their gardens. Dates will be announced at a later time. Inquiries can be made by calling Molly Wolfe, 454-2215.

PAT MONCINI

New Members of the Arboretum Foundation

We are pleased to welcome the following new members (December 1, 1978 through February 28, 1979):

Sustaining—Mrs. Earl W. Fleehart. *Annual*—Mrs. Dori Becker, Sheldon Biback, Mrs. Eve Bollard, Mrs. Peggy Booth, Brad & Margaret Bradley, Tamara Buchanan, Ann Bucher, Mrs. Hilda Crouch, Bethanne D'Amico, Mrs. J.H. Dwinnell, Sue Edwards, Everett Community College, George G. Heiser, Ruth Hofmann, Miss Ruth Jeffries, Martha C. Jones, Mrs. Gretchen Jovanovich, Leona F. Judd, Mrs. Ken T. Krekow, Mary L. La Berge, Mrs. Paul Laush, Phillips H. Lovering, Mrs. Elizabeth S. Luthy, Mrs. Beryl A. Mac Lean, Ms. Phyllis Meck-Emery, Mrs. Theresa Miller, Ms. Myrna A. Molberg, Mr. & Mrs. Malcolm Moore, Mrs. Richard Morris, Mrs. James Munn, Mrs. Jack North, Mrs. David J. O'Brien, Olympic College Library, Mrs. Eugene H. O'Neil, Mrs. Marilyn C. O'Neill, Mrs. Betty Parsons, Ms. Virginia Powers, Mrs. Mark A. Rauch, Dennis J. Scott, Mrs. Phillip Sekella, Mrs. Marcia H. Smith, Mrs. Pattie Stanley Smith, Mary Lou Thomas, Mrs. Milton B. Titus, University of North Dakota, Richard Van Klaveren, Linda Vorobik, James M. Walker, Ruby D. Warren, Mrs. Connie White, Mr. & Mrs. Arthur R. Winder, Alana Zaffiro.

University of Washington Classes

Spectrum, the quarterly journal for Continuing Education, is sent free to those who have indicated interest in the University of Washington's night courses, adult education classes, concerts and other programs. Those who wish to obtain early notice of such classes and registration forms are urged to place their names on the mailing list by calling 543-2590.

Continuing Education

EXPLORING SEATTLE IV. Coordinator Polly Dyer, Public Services Coordinator, UW Institute for Environmental Studies. This popular series consists of seven evening-long field trips by bus, which leaves from campus and serves as a "lecture hall" en route. Topics range from prehistoric ecosystems to farm land preservation to our relationships with the ubiquitous water—all to discover how Seattle's natural and man-made environments interact. Among other locations, you will visit the Union Bay shoreline, the College of Fisheries and the fish ladder at the Ballard Locks, slide areas in Magnolia Bluff and Discovery Park, and the Sammamish Valley. Wednesdays, June 20-August 8 (holiday July 4); 7-9:45 p.m.; 7 sessions, $40 (bus transportation included).

FIELD TRIPPING ON CAMPUS: A BOTANICAL SURVEY. Instructor: Matsuo Tsukada, Professor, Botany. The University of Washington campus is known for its extraordinary variety of native Northwest trees and plants as well as for many rare and exotic plants from Asia, South America and the rest of the world. This one-day field course will teach you how to identify many of these trees and plants and offer information on pruning, propagating and maintaining them in your own garden. A lecture and slide presentation will be followed by outdoor sessions. Saturday, July 14; 9 a.m.-4 p.m.; $20. Bring your lunch or eat in the HUB.

To register, call the Office of Continuing Education, 543-2590.

There will be no Arboretum Courses offered during the summer, but we call attention to the Historic Tour of English Gardens, offered by the U.W.'s College of Forest Resources, and led by Brian and Margaret Mulligan. This will take place in late September and early October of 1979. For further information, call the College of Forest Resources, 543-2730.

MISSING PAGES IN YOUR LAST ISSUE?

We know of at least five copies of the Arboretum Bulletin's last issue that were lacking pages 1 to 4 and 37 to 40—including your editor's private (membership) copy! If you, too, have missing pages in your spring issue of the *Bulletin,* please call the office (325-4510) and we shall send you a duplicate.

"PLANTAE OCCIDENTALIS" EXTENDED

We are pleased to announce the extension to September 2, 1979 of the exhibition "Plantae Occidentalis: 200 Years of Botanical Art in British Columbia." This exhibit, which is currently on display at the University of British Columbia's Museum of Anthropology in Vancouver, is sponsored by U.B.C.'s Botanic Garden. It will certainly augment the tourist attractions of this lovely city during the coming summer and is well worth a special trip to Vancouver for those who live in western Washington.

CALENDAR OF EVENTS

Arboretum Foundation Board of Directors	September 13
Unit Council Governing Board	September 6
Unit Council Meeting	September 20

Most study groups meet irregularly during summer. For regular times the reader is referred to previous issues of the *Bulletin.*

For summer Explorers' Walks see Back Cover.

UNIT COUNCIL SUMMER CUTTING PARTIES: call Molly Wolfe, 454-2215, for schedule.

N.O.H.S. FERN SALE: June 14-16; see previous issue for details.

"PLANTAE OCCIDENTALIS: 200 YEARS OF BOTANICAL ART IN BRITISH COLUMBIA," the exhibit in Vancouver, has been extended to September 2nd.

9TH ANNUAL ARBORETUM FOUNDATION FALL BULB SALE: October 2 & 3
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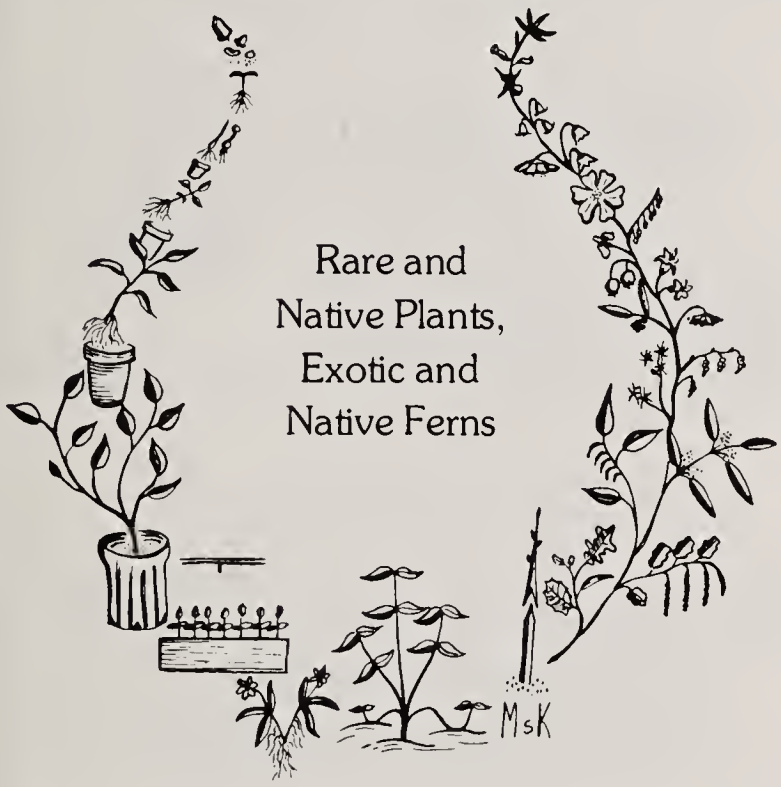

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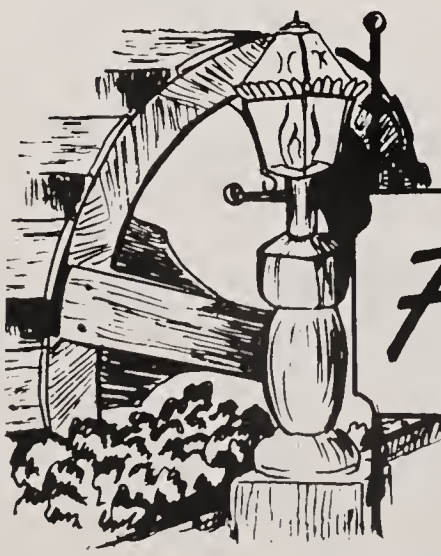

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Pool and Tudor-style laboratory building at R.H.S. Garden, Wisley. Photo: Brian O. Mulligan

VISIT THE ARBORETUM IN SUMMER AND ENGLAND IN AUTUMN

"A Historical Tour of English Gardens" is the title of a tour to be led early this autumn by our own Brian and Margaret Mulligan. Since coming to the Arboretum from England in 1946, the Mulligans have returned regularly to the British Isles, reinforcing their knowledge of the outstanding private and public gardens which abound there. The following paragraphs are quoted from *Spectrum,* the University of Washington's quarterly journal for Continuing Education:

"The College of Forest Resources is sponsoring a non-credit historical tour of English gardens September 19th to October 10th, 1979. The tour will be led by Brian O. Mulligan, Director Emeritus of the University of Washington Arboretum and a Vice-President of the Royal Horticultural Society. The tour will trace five centuries of garden design in England and will visit gardens and houses dating from the time of Henry VIII to the present. Among those scheduled are Hampton Court Palace (built by Cardinal Wolsey and later owned and inhabited by Henry VIII), Sissinghurst, Wakehurst Place, Blenheim Palace (built by John Churchill, the first Duke of Marlborough), Savill Garden in Windsor, the Botanic Garden in Bath and the famous Royal Botanic Gardens at Kew.

"Mr. Graham Thomas, former garden advisor to the National Trust, will give illustrated lectures on the reconstruction and restoration of the older gardens."

The price is approximately $2200 including round trip fare from Seattle. The tour is limited to a small group, so early registration is recommended. For further information, call the College of Forest Resources, 543-2730.

Join the Explorers' Walks, meeting every fourth Wednesday of the month, in the parking lot of the Administration Buildings at 10 A.M., June 27, July 25, August 22, September 26. As of press time, an additional walk has been scheduled on June 13. For possible extra scheduling, call the Arboretum office, 325-4510.